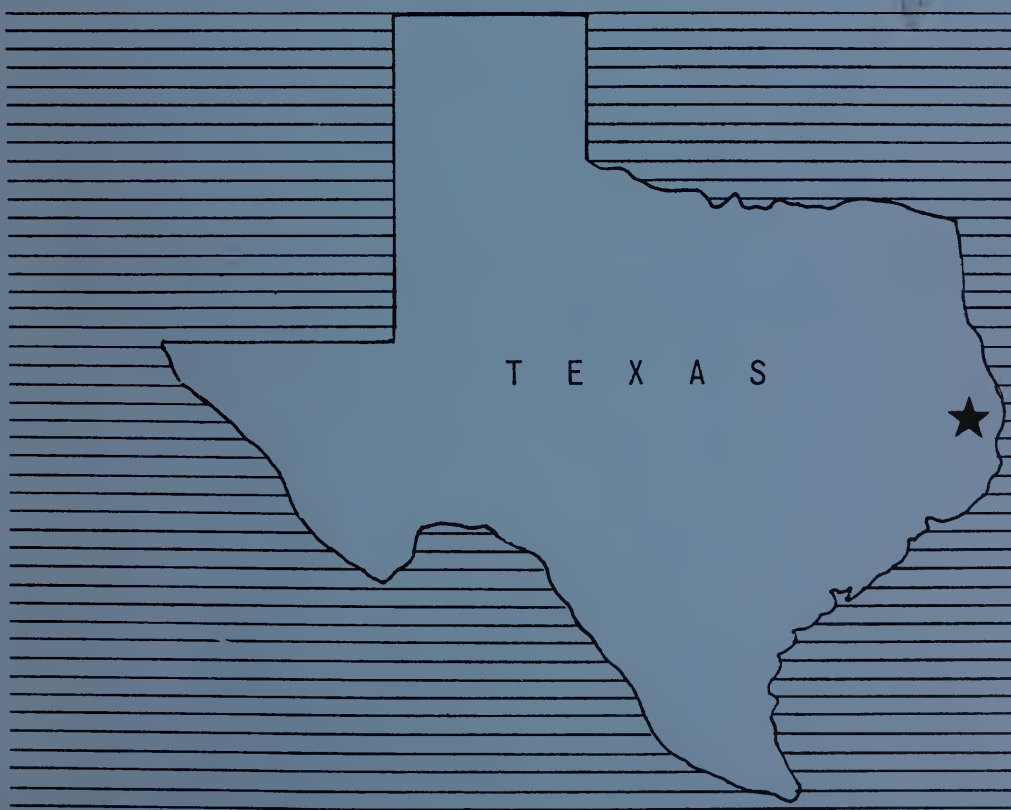
WATERSHED WORK PLAN
FOR
WATERSHED PROTECTION AND FLOOD PREVENTION

SANDY CREEK WATERSHED

JASPER COUNTY, TEXAS



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ADDENDUM
SANDY CREEK WATERSHED, TEXAS

INTRODUCTION

This addendum is based on the Water Resource Council's "Principles and Standards for Planning Water and Related Land Resources," which became effective October 30, 1973. It is prepared to be consistent with the requirements of the Water Resource Council's Procedure No. 1 for the phase-in of the Principles and Standards. The information presented is:

Part I - Benefits to Cost Comparison

An evaluation of the selected plan using current normalized prices, current construction costs, and the current interest rate.

Part II - Four Account Displays

Evaluated effects of the selected plan are displayed under separate accounts for (1) National Economic Development, (2) Environmental Quality, (3) Regional Development, and (4) Social Well-Being. The displays are consistent with the intent of the Principles and Standards.

Part III - Abbreviated Environmental Quality Plan

An environmental quality plan, consistent with the intent of the Principles and Standards, but which is abridged in detail, has been developed by an interdisciplinary team. It is an alternative plan to the selected plan and is formulated to enhance environmental quality by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems. This plan was formulated from information and data obtained during the investigative and analysis phases of project planning. Formulation began with the inventory and recognition of the watershed problems and needs. Desired environmental effects, as translated from the problems and needs, provided a basis for examining appropriate water and land resource use and management opportunities. Opportunities that emphasized contributions to the component needs were selected and are shown as plan elements of the abbreviated environmental quality plan. The cost of $4,127,000 for its installation is a preliminary estimate.

Implementation of features of this environmental quality plan would require acceptance by the local people. Adequate legal authorities do exist for installation; however, funding for all plan elements is presently not available through existing legislative authorities.

PART I

This addendum shows the project cost, benefits, and benefit-cost ratio based on a 6-1/8 percent interest rate, current normalized prices and the 1974 price base. Annual project costs, benefits, and benefit-cost ratio are as follows:

1.	Project costs are	$ 60,580
2.	Project benefits are	104,470
3.	The project benefit-cost ratio is	1.7 to 1.0
4.	The project benefit-cost ratio excluding secondary benefits is	1.6 to 1.0

PART II
Selected Plan

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Sandy Creek Watershed, Texas

Components	Measures of effects 1/	Components	Measures of effects 1/
Beneficial effects:		Adverse effects:	
A. The value to users of increased outputs of goods and services		A. The value of resources required for a plan.	
1. Flood prevention	$100,940	1. Six floodwater retarding structures and 2.9 miles of floodway.	
		a. Project installation	$46,150
		b. Project administration	6,980
		c. Operation and maintenance	5,240
Total beneficial effects	$100,940	Total adverse effects	$58,370
		Net beneficial effects	$42,570

A2

1/ Average annual

September 1975

Selected Plan

REGIONAL DEVELOPMENT ACCOUNT

Sandy Creek Watershed, Texas

Components	Measures of effects 1/	
	Region 2/	Rest of Nation
A. Income:		
Beneficial effects:		
1. The value of increased output of goods and services to users residing in the region.		
a. Flood prevention	$100,940	-
b. Secondary	8,380	-
Total beneficial effects	$109,320	-
A. Income:		
Adverse effects:		
1. The value of resources contributed from within the region to achieve the outputs.		
a. Six floodwater retarding structures and 2.9 miles of floodway.		
Project installation (structural measures)	$ 5,560	$40,590
Project Administration	240	6,740
Operation and Maintenance	5,240	-
Total adverse effects	$11,040	$47,330
Net beneficial effects	$98,280	-$47,330

1/ Average annual
2/ The region consists of Jasper County, Texas

A3

September 1975

Selected Plan
REGIONAL DEVELOPMENT ACCOUNT (continued -2)
Sandy Creek Watershed, Texas

Components	Measures of effects 1/	
	Region 2/	Rest of Nation
B. Employment		
Beneficial effects:		
1. Increase in the number and types of jobs.		
a. Employment for project construction.	31 man-years of semi-skilled employment during the installation period (5 years).	---
Total beneficial effects	31 man-years of semi-skilled employment over the installation period (5 years).	---

Components	Measures of effects 1/	
	Region 2/	Rest of Nation
B. Employment:		
Adverse effects:		
1. Decrease in number of jobs.	0	0
Total adverse effects	0	0
Net beneficial effects	31 man-years of semi-skilled employment over the installation period (5 years).	

1/ Average annual

2/ The region consists of Jasper County, Texas

September 1975

Selected Plan

REGIONAL DEVELOPMENT ACCOUNT (Continued-3)

Sandy Creek Watershed, Texas

Components	Measures of effects	
	Region 1/	Rest of Nation
Population Distribution		
Beneficial effects	Create 31 man-years of semi-skilled employment over the installation period (5 years).	---
Adverse effects	---	---
Regional Economic Base and Stability		
Beneficial effects	Create 31 man-years of semi-skilled employment over the installation period (5 years). Reduce flood hazard on about 1,045 acres of flood plain. Reduce flood hazard to owners and occupants of about 40 homes and 30 businesses in Jasper.	---
Adverse effects	---	---

1/ The region consists of Jasper County, Texas

September 1975

Selected Plan

SOCIAL WELL-BEING ACCOUNT

Sandy Creek Watershed, Texas

Components	Measures of Effects
Beneficial and adverse effects:	
A. Real Income distribution	1. Create 31 man-years of semi-skilled employment over the installation period (5 years).
	2. Create regional benefit distribution of $109,320 annually by income class as follows:

Income Class (dollars)	Percentage of Adjusted Gross Income in Class	Percentage Benefits in Class
Less than 3,000	7	2
3,000 - 10,000	43	15
More than 10,000	50	83

	3. The local annual cost of $11,040 will be borne by the City of Jasper and financed by tax revenue. The percentages of contribution to local costs by income classes is not readily available.
B. Life, health, and safety	1. Provide protection from the 100-year event to 40 houses and 30 businesses in Jasper with population of 6,251 in 1970. Future threats of loss of life and displacements during floods will be eliminated.

September 1975

Selected Plan

ENVIRONMENTAL QUALITY ACCOUNT

Sandy Creek Watershed, Texas

Components	Measures of effects
Beneficial and adverse effects:	
A. Areas of natural beauty.	1. Create 62 surface acres of water.
	2. Inundate 62 acres of forest land.
B. Quality considerations of water and land resources.	1. Reduce average gross erosion rate from 4.8 tons to 2.1 tons per acre per year.
	2. Sediment originating in the watershed will be reduced by an average of 11 acre-feet annually. Suspended sediment concentration carried by runoff water leaving the watershed will be reduced from 430 to 150 mg/1.
	3. Reduce sediment deposition to B.A. Steinhagen Reservoir by 2.8 acre-feet annually.
	4. Improve quality of air.
	5. Improve quality of water.
	6. Provide adequate fire prevention and control measures.
C. Biological resources and selected ecosystems.	1. Enhance habitat and food supply and provide improved watering areas for upland game and waterfowl.
	2. Create 62 surface acres of lake fish habitat.
	3. Provide 62 acres at the reservoir for migratory waterfowl resting areas.
D. Irreversible or irretrievable commitments.	1. Conversion of 148 acres of forest lands and pastureland to dams, emergency spillways, and sediment pools.

PART III

ABBREVIATED ENVIRONMENTAL QUALITY PLAN

Sandy Creek Watershed, Texas

The goals of this environmental quality plan for the Sandy Creek watershed are to preserve and enhance areas of natural beauty; maintain and improve the quality of the water, land, and air resources; and preserve and enhance the biological resources and ecosystems of the watershed so that man can live in an esthetically and culturally pleasing environment.

The principal environmental quality problem is the application of watershed management as related to supervision, regulation, maintenance, and wise use of the aggregate resources of the drainage basin to provide the maximum water yield of desirable quality, including the control of erosion, pollution, and floods. Soil is the basic resource in this watershed. It is essential to protect and improve the condition of the soil and the vegetation it supports because these two resources have a marked influence on the quality and quantity of water contributed for downstream use. The use of various control measures and management practices is essential to conserve, improve, and enhance the water and forestry resources to provide water needs for municipal, industrial, agricultural water supplies, fisheries, and recreation. In carrying out a quality plan for the various functional activities on the watershed lands, including grazing of livestock and game, logging, road-building, fire control, sewage disposal, and recreation, it is important that satisfactory watershed environmental conditions be preserved. Increased population growth and economic progress in the watershed will necessitate

extending home tract developments into the upper reaches of the watershed and more intensively utilizing the resources in presently developed areas. This trend is currently being experienced. In the utilization and development of land and water resources the local government agencies and private enterprises must consider it their responsibility to implement adequate safe guard controls to preserve the quality of water in presently undeveloped areas and maintain the natural ecosystem.

The watershed lies within a scenic rural setting of hilly forested-lands consisting of pine and hardwoods interspersed with some improved pastureland. Clearing for commercial timber production has caused temporary loss of wildlife habitat and contributed to the sediment load of Sandy Creek. Also active roadside and streambank erosion contribute to the sediment load. Flooding of urban developments on the flood plain in Jasper poses a threat to the lives, property, and livelihood of residents and businesses.

Component needs for solving problems relating to specific environmental conditions are listed below:

1. Areas of Natural Beauty
    a. Reduce sheet, gully and roadside erosion in the uplands.
    b. Maintain a diversity of landscapes.
    c. Maintain needed litter and cover in areas of commercial timber production and establish new forest growth.
    d. Reduce streambank and flood plain erosion on Sandy Creek and its tributaries.

e. Create sanitary land fills for residents living outside the city of Jasper.

2. Quality of Water, Land, and Air Resources

a. Improve the quality of the streamflow by reducing the sediment being delivered to the streams and lakes from streambank erosion, roadside and gully erosion and sheet erosion.

b. Protect the land resource base from deterioration by reducing streambank erosion, public roadside and gully erosion, sheet erosion, and sediment deposition.

c. Maintain and enhance the productivity of the land resource base.

d. Improve quality of the air by reducing smoke associated with industry.

e. Improve quality of the water by reducing pollutants associated with industry.

f. Prevent damage and destruction of homes, businesses, transportation systems, and sources of livelihood of human inhabitants by flooding.

g. Develop long range plans for logging operations to include location and construction of logging roads to reduce erosion and improve water quality.

h. Provide adequate fire prevention and control measures to preserve the quality of the natural ecosystem.

3. Biological Resources and Ecosystems

a. Preserve and enhance the habitat conditions for species of

fish and wildlife present in the watershed by:

(1) Eliminating indescriminant destruction of the habitat.

(2) Provide more dependable food supplies.

(3) Reduce damage to habitat from flooding, sedimentation, etc.

(4) Creating additional cover for selected species of wildlife.

(5) Creating additional habitat for fish.

The plan elements for environmental quality consist of a system of management practices, land treatment measures, structural measures, and land acquisition.

The land treatment measures would include vegetative practices and management, and mechanical treatment to be applied to the land by the land users. Land users would be encouraged to apply and maintain these measures by the local soil and water conservation districts with technical assistance to be supplied by the Texas Forest Service, U.S. Forest Service and the Soil Conservation Service. Financial assistance, usually on a cost-share basis, is available through programs such as the new Rural Environmental Conservation Program administered by the Agricultural Stabilization and Conservation Service.

Installation of six single purpose flood water retarding structures and 2.9 miles of floodway would reduce flood stages on Sandy Creek and its tributaries.

Installation and maintenance of 15 roadside erosion control measures and vegetation of 6 miles of county road rights-of-way to protect cut and fill

areas and reduce sediment pollutants to Sandy Creek. This would be accomplished by the county government.

The county and city governments would institute flood plain management to prevent encroachment by damage-prone improvements within the 100-year with project conditions flood plain.

The Jasper County governing body would install and maintain two sanitary land fills for residents living outside the city of Jasper.

Develop long range plans with commercial timber companies on areas where logging is permitted by the controlled cutting of timber essential to maintaining scenic values, preserve wildlife habitat and prevent water pollution. This element would be implemented by the Texas Forest Service, private timber companies and county government.

Implement an adequate fire prevention and control measures plan by working with land users in the watershed by holding public meetings annually to develop public awareness and assess future needs. This element would be implemented by the Texas Forest Service, land users, and the county government.

The city of Jasper would create a community recreation and park on the 100 year with project conditions flood plain within the city limits. Also, small channel dams and raceways for fish habitat and canoeing would be installed by the city of Jasper within its corporate limits.

The city and county governments would institute regulatory ordinances to

prevent industry from polluting the air with smoke and discharging water polluting industrial wastes into Sandy Creek.

A tertiary sewage treatment plant would be constructed on an upland area replacing the present facility site in the flood plain of Sandy Creek. This element would be implemented by the city government.

The estimated installation costs of these elements of the environmental quality plan are as follows:

1. Completion of the application of land treatment measures: $165,000
2. Six single-purpose floodwater retarding structures and 2.9 miles of floodway: $902,000
3. Install fifteen roadside erosion control measures and vegetate about six miles of county road rights-of-way: $60,000
4. Flood plain management program for Sandy Creek and its tributaries: No installation cost
5. Install two sanitary landfills: $90,000
6. Creation of a 130 acre recreation and park area: $400,000
7. Regulatory ordinances for prevention of air and water pollution: No installation cost
8. New sewage treatment plant with tertiary treatment: $2,500,000
9. Develop plans for logging operations: $5,000
10. Provide fire protection and control measures: $10,000

The total installation cost of the environmental quality plan is estimated to be $4,132,000.

The environmental effects that would result from installation of the environmental plan are as follows:

1. Areas of Natural Beauty

   a. Enhance the appearance of five wood using forests industries, and 30 farms in the watershed through application and maintenance of land treatment measures.

   b. Maintain the diversity of landscape through preservation and management of hardwood and pine-hardwood forest communities on about 5,000 acres on and adjacent to stream channels.

   c. Enhance the scenic quality of the spring-fed stream of Sandy Creek by reducing water borne pollutants.

   d. Improve the scenic quality of six miles roadside erosion areas by shaping and revegetation.

   e. Superimpose the dams of floodwater retarding structures and pools of water into the forested areas of the watershed.

2. Quality of Water, Land, and Air Resources

   a. Reduce the sediment load carried by Sandy Creek and its tributaries through reduction of sheet erosion, gully erosion, and streambank erosion.

   b. Prevent the deterioration of the land resource base by providing protection from erosion by installing needed vegetative and mechanical treatment measures.

   c. Maintain and enhance the productivity of the land resource base by applying agronomic and vegetative management practices.

d. Reduce flooding on 410 acres of urban land in Jasper and 685 acres of agricultural land.

e. Prevent destruction of lives, urban and agricultural properties, and source of livelihood for about 86 owners of property on the flood plain of Sandy Creek.

f. Reduce the interruption of the transportation system at crossings along the flood plain.

g. Encourage preservation of open space on the flood plain through zoning, restrictions, or management programs. Also reduce the possibility of increased damages due to future developments on the flood plain.

h. Reduce sediment load carried downstream into B.A. Steinhagen Reservoir.

3. Biological Resources and Selected Ecological Systems

a. Improve the fishery habitat in the streams and farm ponds by reducing sediment content of runoff.

b. Improve habitat for some wildlife species, such as deer, as the result of improvement of plant composition in the forest.

c. Improve wildlife habitat on upland through installation of certain land treatment measures.

d. Change 62 acres of forest wildlife habitat to fish habitat and waterfowl resting areas.

4. Irreversible or Irretrievable Commitments

a. Require the loss of 148 acres of forest lands and pastureland

for installation and functioning of the floodwater retarding structures.

b. The use of 108 acres within the city of Jasper for the proper functioning of the floodway.

c. Require labor, energy, and materials for construction of improvements.

WATERSHED WORK PLAN AGREEMENT

between the

Jasper-Newton Soil and Water Conservation District
Local Organization

Upper Jasper County Water Authority
Local Organization

City of Jasper
Local Organization

(hereinafter referred to as the Sponsoring Local Organization)

State of Texas

and the

Soil Conservation Service
United States Department of Agriculture
(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works of improvement for the Sandy Creek watershed, State of Texas, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, 68 Stat.666), as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organization and the Service a mutually satisfactory plan for works of improvement for the Sandy Creek Watershed, State of Texas, hereinafter referred to as the watershed work plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about five years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. The Sponsoring Local Organization will acquire, with other than Public Law 566 funds, such land rights as will be needed in connection with the works of improvement. (Estimated Cost $94,350).

2. The Sponsoring Local Organization assures that comparable replacement dwellings will be available for individuals and persons displaced from dwellings, and will provide relocation assistance advisory services and relocation assistance, make the relocation payments to displaced persons, and otherwise comply with the real property acquisitions policies contained in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. The costs of relocation payments will be shared by the Sponsoring Local Organization and the Service as follows:

	Sponsoring Local Organization (percent)	Service (percent)	Estimated Relocation Payment Costs (dollars)
Relocation Payments	23.74	76.26	0 1/

1/ Investigation has disclosed that under present conditions that project measures will not result in the displacement of any person, business or farm operation. However, if relocations become necessary, relocation payments will be cost-shared in accordance with the percentages shown.

3. The Sponsoring Local Organization will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to state law as may be needed in the installation and operation of the works of improvement.

4. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organization and by the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Construction Cost (dollars)
Six Floodwater Retarding Structures and Floodway	0	100	644,830

5. The percentages of the engineering costs to be borne by the Sponsoring Local Organization and the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Engineering Costs (dollars)
Six Floodwater Retarding Structures and Floodway	0	100	43,620

6. The Sponsoring Local Organization and the Service will each bear the costs of Project Administration which it incurs, estimated to be $4,000 and $114,380 respectively.

7. The Sponsoring Local Organization will obtain agreements from owners of not less than 50 percent of the land above each reservoir and floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.

8. The Sponsoring Local Organization will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.

9. The Sponsoring Local Organization will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.

10. The Sponsoring Local Organization will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.

11. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.

12. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the availability of appropriations for this purpose.

    A separate agreement will be entered into between the Service and the Sponsoring Local Organization before either party initiates work involving funds of the other party. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

13. The watershed work plan may be amended or revised, and this agreement may be modified or terminated only by mutual agreement of the parties hereto except for cause. The Service may terminate financial and other assistance in whole, or in part, at any time whenever it is determined that the Sponsoring Local Organization has failed to comply with the conditions of this agreement. The Service shall promptly notify the Sponsoring Local Organization in writing of the determination and the reasons for the termination, together with the effective date. Payments made to the Sponsoring Local Organization or recoveries by the Service under projects terminated for cause shall be in accord with the legal rights and liabilities of the parties.

14. No member of or delegate to congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; But this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

15. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964 and the regulations of the Secretary of Agriculture (7 C.F.R. 15.1-15.12), which provide that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any activity receiving federal financial assistance.

16. This agreement will not become effective until the Service has issued a notification of approval and authorizes assistance.

Jasper-Newton Soil and Water Conservation District
Local Organization

105 Courthouse Building
Jasper, Texas 75951
Address Zip Code

By E. P. Brooks
E. P. Brooks
Title Chairman

Date 9/23/75

The signing of this agreement was authorized by a resolution of the governing body of the Jasper-Newton Soil and Water Conservation District
Local Organization
adopted at a meeting held on September 23, 1975

Secretary, Local Organization
Elmer C. Carruth
Date 9/23/75

105 Courthouse Building
Jasper, Texas 75951
Address Zip Code

Upper Jasper County Water Authority
Local Organization

P. O. Box 640
Jasper, Texas 75951
Address Zip Code

By Carl T. Bledsoe, Jr.
Carl T. Bledsoe, Jr.
Title Chairman

Date 10/17/75

The signing of this agreement was authorized by a resolution of the governing body of the Upper Jasper County Water Authority
Local Organization
adopted at a meeting held on October 16, 1975

Secretary, Local Organization
Gene F. Rhodes
Date 10/17/75

P. O. Box 640
Jasper, Texas 75951
Address Zip Code

City of Jasper
Local Organization

272 E. Lamar Street
Jasper, Texas 75951
Address Zip Code

By Wayne DuBose
Wayne DuBose
Title City Manager

Date 10/17/75

The signing of this agreement was authorized by a resolution of the governing body of the City of Jasper
Local Organization
adopted at a meeting held on October 13, 1975

Robert Watts
Secretary, Local Organization
Robert Watts
Date 10/17/75

272 E. Lamar Street
Jasper, Texas 75951
Address Zip Code

Appropriate and careful consideration has been given to the environmental impact statement prepared for this project and to the environmental aspects thereof.

Soil Conservation Service
United States Department of Agriculture

Approved by:

Edward E. Thomas
State Conservationist

OCT 31 1975
Date

WATERSHED WORK PLAN

FOR

WATERSHED PROTECTION AND FLOOD PREVENTION

SANDY CREEK WATERSHED

Jasper County, Texas

Prepared Under the Authority of the Watershed Protection and Flood Prevention Act, (Public Law 566, 83rd Congress, 68 Stat. 666), as amended.

Prepared By:

Jasper-Newton Soil and Water Conservation District
(Sponsor)

City of Jasper
(Sponsor)

Upper Jasper County Water Authority
(Sponsor)

With Assistance By:

U. S. Department of Agriculture
Soil Conservation Service
and
Forest Service

September 1975

4-33994 3-75

WATERSHED WORK PLAN

SANDY CREEK WATERSHED

Jasper County, Texas

September 1975

SUMMARY OF PLAN

This work plan for watershed protection and flood prevention for Sandy Creek Watershed has been prepared by the Jasper-Newton Soil and Water Conservation District, the City of Jasper, Texas and the Upper Jasper County Water Authority as sponsoring local organizations. Technical assistance has been provided by the Soil Conservation Service and the Forest Service, United States Department of Agriculture. The U.S. Fish and Wildlife Service, United States Department of the Interior, in cooperation with the Texas Parks and Wildlife Department, made a reconnaissance study of the fish and wildlife resources of the watershed.

Financial assistance in developing the work plan was provided by the Texas State Soil and Water Conservation Board.

Sandy Creek watershed comprises an area of 39.06 square miles in the northern portion of Jasper County, Texas. It is estimated that 2.8 percent of the watershed is pastureland, 85.2 percent is forestland, and 12.0 percent is in miscellaneous uses such as the City of Jasper, public roads, farmsteads, railroad rights-of-way and stream channels.

The principal problem within the watershed is one of extensive and frequent flooding on portions of the 1,095 acres of flood plain, causing minor damages to agricultural properties and major damages to urban properties.

Total floodwater, indirect damages, and sediment derived from the watershed and delivered to B.A. Steinhagen Lake, are estimated to average $108,740 annually.

Project objectives are the proper use, treatment, and management of soil and water resources in the watershed, the protection of flood plain lands and property, and the stimulation of economic development of the area as a result of project installation. The project as formulated meets these objectives.

Land users will apply and maintain land treatment measures on pastureland and forestland during the project installation period. In addition to maintaining existing applied measures land users will install land treatment measures on an additional 5,300 acres of forestland and 200 acres of pastureland during the project installation period. Wildlife upland habitat management will also be applied on watershed lands which have a secondary use as wildlife land. The installation cost of these land treatment measures is estimated to be $164,610, of which $154,710 will be from funds other than Public Law 566. Public Law 566 funds will provide $9,900 which will be used by the U.S. Forest Service in cooperation with the Texas Forest Service.

The structural measures in this plan are six floodwater retarding structures and 2.9 miles of floodway to be installed in a five-year installation period. The total estimated cost of these measures is $901,180, of which the local share is $98,350 and the Public Law 566 share is $802,830. The local share of the cost consists of land rights and project administration. Installation of the project will contribute to the conservation, orderly development, and productive use of the watershed's soil, water, and related resources.

Watershed lands will be protected from erosion, sediment yielded to flood plain areas will be decreased, and the sediment accumulation rate in B.A. Steinhagen Lake will be reduced. The project will provide damage reduction to 1,095 acres of flood plain within the watershed and will benefit directly 15 owners and operators of agricultural land in the flood plain, the owners and occupants of 40 residential units, and the owners and operators of 30 business units in the flood plain. Additional water impoundment areas will be created and can be used for recreation, waterfowl feeding and resting areas, development of fisheries, and livestock and wildlife watering areas.

Additional opportunities for employment during construction of structural measures will be created effecting a greater potential for increased income to household's and demand for services.

Installation of the six floodwater retarding structures will require 528 acres of land. A total of 148 acres of this area will be needed for dams, emergency spillways, and sediment pools up to the lowest ungated outlets. Most of the existing vegetation on this 148 acres will be destroyed during construction. About 60 acres of this area is bottomland habitat for swamp rabbit, mink, and gray squirrel. Measures to reduce or minimize this habital loss will be installed. All exposed areas will be revegetated with multiple-use plants to control erosion and provide food and cover for wildlife.

A floodway requiring about 108 acres within the City of Jasper will be installed. It will be approximately 400 feet wide and total 15,300 feet in length. The floodway will not generally be excavated or leveed, but will be developed by clearing the dense underbrush and small trees adjacent to, and where possible, on both sides of the existing stream channel. Fallen trees and logs will be removed from the existing stream channel. Sufficient mast producing tree species and numerous plant species will be left for wildlife and aesthetic value.

Average annual damages will be reduced from $108,740 to $1,230 by the proposed project. Average annual benefits accruing to the structural measures in the watershed will be $109,320 which includes $100,940 damage reduction benefits and $8,380 secondary benefits. The ratio of total average annual benefits accruing to the structural measures ($109,320) to the average annual cost of these measures ($58,370) is 1.9:1.0.

Land treatment measures will be maintained by owners and operators of the land on which the measures will be applied under agreement with the Jasper-Newton Soil and Water Conservation District.

The City of Jasper will be responsible for the operation and maintenance of the six floodwater retarding structures, floodway, and measures to reduce or minimize wildlife habitat losses. The cost of operation, maintenance, and replacement is estimated to be $5,240 annually.

WATERSHED RESOURCES - ENVIRONMENTAL SETTING

Physical Data

Sandy Creek watershed is within the Texas Gulf Water Resource Region and comprises an area of 25,000 acres, or about 39.06 square miles. The watershed is located in the northern portion of Jasper County, Texas, approximately 120 miles northeast of Houston, Texas; 70 miles north of the Beaumont-Orange-Port Arthur area; and 30 miles west of the Texas-Louisiana State line.

Sandy creek is a perennial stream that rises approximately 10 miles north of the City of Jasper. It flows in an unmodified, well defined channel in a southerly direction to the eastern edge of the City. Its course then turns to a southwesterly direction within the City and continues for about 2.4 miles in a modified, well defined channel. It then enters a 0.25 mile segment with no defined channel. The lack of a defined channel is the result of sediment accumulation in the area. Sandy Creek continues southwesterly for 10 miles, discharging into B.A. Steinhagen Lake on the Neches River. The two principal tributaries in the watershed are Trotti Creek and Little Sandy Creek which flow into Sandy Creek within the city limits of Jasper. The lower limit of the watershed, as considered for work plan development, is immediately upstream from Texas State Highway 63.

In 1934, a portion of Sandy Creek, starting near Farm Road 776 and terminating near the city sewage treatment plant, was straightened and enlarged by a Civil Works Administration Project. Remnants of this project are nonexistent due to a sediment accumulation, growth of vegetation, and lack of maintenance.

There are no existing or proposed water resource development projects of other agencies within the watershed.

Geologic strata cropping out in the watershed are shown in the following tabulation: 1/

SYSTEM	SERIES	FORMATION
Quaternary	Recent	Alluvium
	Pleistocene	Willis
Tertiary	Miocene	Fleming
		Catahoula

1/ Refer to "Geologic Atlas of Texas" Beaumont and Palestine Sheets; University of Texas, Bureau of Economic Geology

There is no folding or faulting of geologic strata in the watershed or surrounding area. All rock in the area dip gently to the south and the strike is east-west.

The Catahoula Formation is the oldest geologic rock unit in the watershed. Its outcrop is a relatively small area in the northern portion of the watershed. Elsewhere in the watershed the Catahoula Formation is overlain conformable by the Fleming Formation and unconformably by the Willis Formation. The Catahoula Formation is comprised of sandy, tuffaceous, light gray mudstone in its upper horizons that weathers to dark gray color. The lower 10 to 80 feet is mostely polished, coarse grained, quartz sand commonly cemented with opal. The total thickness of the Catahoula Formation is 250 to 300 feet.

The Fleming Formation within the watershed has a dendritic shaped outcrop that has been exposed by erosion in the drainage system of stream channels. The formation is composed mostly of calcareous clay, however, indurated silt and sand are locally predominant. Unweathered bedrock is commonly light gray to yellowish gray which weathers to light gray or red near its contact with the Willis Formation. The thickness of the Fleming Formation is from 1,300 feet to 1,450 feet.

The Willis Formation is the predominant geologic outcrop within the watershed in areal extent and occupies the topographically high areas. This formation was deposited unconformably on underlying strata in the watershed. Except in extremely dry extended periods of time, springs issue from a perched water table at the contact between the Willis Formation and Fleming or Catahoula formations. The flow of major streams is perennial as a result of discharge from these springs. The Willis Formation is comprised of clay, silt, sand, and silicious gravel of granule to pebble size with some petrified wood. The formation is generally deeply weathered and lateritic; indurated by clay and locally cemented with iron oxide.

Recent alluvium in the watershed is dominantly fine grained sand with lesser amounts of silt and clay. Organic matter is locally abundant. The top of the water table in these deposits ranges in depth from ground level to approximately five feet below the surface.

The topography is nearly level in the flood plain and gently sloping to rolling on the uplands. Elevations range from approximately 520 feet above mean sea level along the northern boundary of the watershed to about 180 feet at the mouth of the watershed.

The climate is warm and sub-humid. Mean monthly temperatures range from 93 degrees Fahrenheit in July to 40 degrees in January. The normal growing season is 229 days, extending from March 23 to November 6. The average annual rainfall of 52.4 inches is generally well distributed throughout the year, however the greatest amounts of precipitation usually fall during the months of May, December, and January.

The soils in the watershed occur as well dissected upland, wet and organic laden colluvium and recently deposited alluvium. This region of soils is in the southern Coastal Plain Land Resource Area.

The upland areas are gently sloping to steep and have a dendritic drainage system. Wagram, Lucy, Bowie, Sacul, Tenaha and Kirvin are the main soils occurring as uplands. Wagram, Lucy, and Tenaha are somewhat droughty soils with a thick loamy sand surface layer. Runoff is slow to medium on these soils. However, on the Sacul and Kirvin soils, the runoff is medium to rapid

due to the clayey subsoil. The Bowie soils occur as broad ridges that are gently sloping and have medium runoff.

The colluvial soils occur at the lower part of many of the sandy uplands. Plummer and Osier are the two main soils occurring in these areas. These soils are wet, and have a thick sandy surface that is darkened with organic matter. These soils are nearly ponded.

The alluvial areas are mostly nearly level and are occupied by Iuka and Mamtachie soils. They are sandy loams and clay loams and have a slow runoff.

The upland soils comprise about 80 percent of the area and are the most widely used for agricultural purposes. Many of these soils are highly erosive. The Colluvial soils are wet and the bottomlands flood too frequently to be used extensively.

The watershed is characterized by pine forest in association with hardwood and pine-hardwood stands adjacent to major tributaries and in the flood plain of Sandy Creek. Forested lands comprise 21,300 acres, or 85 percent of the watershed. Pine stands make up 75 percent of the forest cover, hardwood stands 15 percent, and pine-hardwood stands 10 percent.

Pine stands are composed of loblolly pine *(Pinus taeda)*, shortleaf pine *(Pinus echinata)* and longleaf pine *(Pinus palustris)*. Major hardwoods are oaks *(Quercus spp.)*, red maple *(Acer rubrum)*, blackgum *(Nyssa sylvatica)*, beech *(Fagus grandifolia)*, sweetgum *(Liquidamber styraciflua)*, hickory *(Carya spp.)*, magnolia *(Magnolia grandiflora)*, sweetbay *(Magnolia virginiana)*, mulberry *(Morus rubra)*, and ash *(Fraxinus spp.)*. Subdominant trees and understory shrubs include dogwood *(Cornus spp.)*, sumac *(Rhus spp.)*, hawthorns *(Viburnum spp.)*, texas Buckeye *(Aesculus glabra var. arguta)*, american beautyberry *(Callicarpa americana)*, hawthorns *(Crataegus spp.)*, basswood *(Tilia spp.)*, elm *(Ulmus spp.)*, yaupon *(Ilex vomitoria)*, large gallberry *(Ilex coriacea)*, and holly *(Ilex opaca)*. Grasses and grass-like plants which predominate are pinehill bluestem *(Andropogon divergens)*, broomsedge bluestem *(Andropogon virginicus)*, panicums *(Panicum spp.)*, sedges *(Carex spp.)*, and rushes *(Juncus spp.)*.

There is a well balanced distribution of timber stands by size classes.

Land use within the watershed is shown in the following tabulation:

Land Use	Acres	Percent
Pastureland	700	2.8
Forestland	21,300	85.2
Miscellaneous *	3,000	12.0
	25,000	100.0

* Includes roads, highways, railroad rights-of-way, urban area, farmsteads, etc.

The present land use within the flood plain area is as follows: forestland, 59 percent; pastureland, 3 percent; and miscellaneous uses including urban areas, public roads, and railroads, 38 percent.

Grazing, fire, and logging operations have adversely affected the vegetation in many areas with resultant reductions in ground cover, species diversity and erosion protection. Present hydrologic conditions on forestland are 5 percent very good, 30 percent good, 30 percent fair, 10 percent poor, and 25 percent very poor. Hydrologic cover on most native pasture is fair and cover on improved pastures is generally good.

Water for rural, domestic and livestock use is obtained from spring-fed streams, ponds, and shallow wells. The perennial spring-fed streams do not have sufficient yield to be dependable water sources for municipal and industrial needs. Water from these sources is of good quality. The City of Jasper obtains its municipal and industrial water supply from wells located in the Jasper aquifer. Jasper's present population of 6,251 and the projected population of 11,300 by 1992 can be adequately served with the existing system of wells.[1/] Water for additional population and development of heavy water-using industries can be met by developing additional wells.

Mineral resources within the watershed consists of sand and gravel deposits located along Sandy Creek flood plain. These resources are of minor economic significance to the economy of the watershed.

Economic Data

Forestry and related wood using industries comprise the primary economic base within the watershed. The principal wood product is pulpwood, although appreciable volumes of lumber, plywood, and cooperage are produced. Beef cattle, poultry, and poultry products are also important to the local economy. Farm income is supplemented by employment in Jasper, Beaumont, Orange, and Port Arthur.

Five major wood-using industries own and operate over 80 percent of the forestland in the watershed. The remainder of the forestland and pastureland consists of approximately 30 farm units averaging about 100 acres in size. Numerous homesites of one to ten acres occur throughout the watershed.

The estimated current market price of land within the watershed ranges from $300 to $350 per acre. The range in land price depends primarily on location, accessibility, and productive capacity. The large-scale recreational developments on the Sam Rayburn Reservoir, located approximately 10 miles north of Jasper, have created a heavy demand for homesites in the forest environment. It is anticipated that the demand for small tracts will continue to increase as more people seek weekend retreats. Less than 10 percent of the agricultural land is leased or rented.

1/ "Land Use, Population Distribution, Circulation Community Facilities" Preliminary Report 2, Jasper, Texas, Bernard Johnson Engineers, Inc. Houston, Texas

Approximately 85 percent of the farms in the watershed gross less than $2,500 annually from agricultural sales. Approximately 60 percent of the farm operators worked off-the farm for 100 days or more in 1972.

It is estimated that less than five percent of the agricultural land in the benefited area is devoted to farms using 1-1/2 man-years or more of hired labor.

The "Labor Force Estimates for Texas Counties - April 1974", shows a labor force of 8,990 for Jasper County. Approximately 4.4 percent, or 395 workers, are unemployed. This is below the state and national rates of unemployment. Approximately 30.7 percent, 2,645 workers, are employed in the agricultural sector. The nonagricultural sector employs 5,950 workers: 2,350 workers in the manufacturing sector and 3,600 workers in the nonmanufacturing sector.

The City of Jasper, located near the southern end of the watershed, has a population of 6,251 (1970 census). It is the county seat of Jasper County and the commercial center for the surrounding area, providing marketing and supply services which are important in the local economy. Local industries, which employ many residents of the area, include a plywood mill, several sawmills, poultry processing plants, and feed mills. Tourism is also important to the local economy.

The watershed is served adequately by U.S. Highways 96 and 190; State Highway 63; and Farm Roads 776, 777, 2799, and 2800. There are several county roads which provide access to the watershed. The Gulf, Colorado, and Santa Fe Railroad has loading facilities in Jasper.

Jasper County is within the boundaries of the Southeast Texas Resource Conservation and Development Project. This project is a locally initiated, sponsored, and directed project designed to carry out a program of land conservation and land utilization, accelerated economic development, reduction of chronic unemployment or under employment in an area where an impetus is needed to foster a local economy. A basic objective of an RC&D project is the orderly development, improvement, conservation, and utilization of natural resources for benefit of people within the project area. The Southeast Texas Resource Conservation and Development Program is administered by the Soil Conservation Service and covers more than five million acres in Jasper and adjoining counties.

Sponsors of the Southeast Texas Resource Conservation and Development Project have recognized the need for watershed protection and flood prevention on Sandy Creek and concur with local sponsors in the need for implementation of a watershed protection and flood prevention plan.

Fish and Wildlife Resources

The fish and wildlife habitat, species, and populations in the watershed are described by the U.S. Fish and Wildlife Service as follows:

> "The fishery resources in the project area consist of 5 farm ponds totaling 35 surface acres and approximately 32 miles of streams,

of which 17 miles are permanent water. The quality of fish habitat in the farm ponds is good, while that in the streams varies from poor to fair. Deposition of sand in the waterways has eliminated much of the aquatic vegetation and has significantly reduced the quality of fish habitat. Industrial wastes and domestic sewage have further deteriorated the quality of stream habitat in the vicinity of Jasper and downstream. Common fishes in project area waters include largemouth bass, channel catfish, and various species of sunfishes and minnows.

Landowners and residents of Jasper do most of the fishing in the watershed. The amount of sport fishing is light and there is no commercial fishing. Little change in these conditions is expected in the future."

"The project area is within the East Texas Timber Country Game Region. The majority of the uplands provide poor to fair quality wildlife habitat, whereas the bottomlands provide fair to excellent wildlife habitat. Wildlife species in the watershed include white-tailed deer, bobwhite, mourning dove, fox squirrel, gray squirrel, cottontail, swamp rabbit, raccoon, opossum, skunk, mink, bobcat, red fox, gray fox, coyote, and waterfowl.

Wildlife populations in general are low to moderate in upland areas and moderate to high in the bottomlands. The gray squirrel is the most abundant game animal in the project area. Fox squirrels, cottontails, swamp rabbits, raccoons, opossums, and skunks are common whereas white-tailed deer, bobwhites, mourning doves, minks, bobcats, gray foxes, red foxes, and coyotes are relatively scarce in number. A few waterfowl frequent the waterways and ponds within the project area.

Hunting is heavy for white-tailed deer and gray squirrels and is light to moderate for all other game animals. Hunting is light for waterfowl. Some of the commercial timberland is open to public hunting. The majority of hunting in the project area is done by landowners and residents of Jasper. There is some trapping for mink and raccoons.

In the future, wildlife populations in the project area would suffer some losses with the expected intensified timber management practices on commercial forestlands. These practices which lead to the development of even-age, pure softwood stands, would deplete habitat throughout the uplands and lower the carrying capacity for many of the wildlife species that presently inhabit the upland types. Increased exploitation of bottomlands in the vicinity of Jasper would destroy some excellent bottomland habitat which presently provides an essential environment for fur animals.

Hunting demands are expected to increase over the life of the project reflecting the human population growth within the area of influence. Hunting, however, would not necessarily increase as the decline in wildlife numbers within the watershed could discourage many of the hunters and spur them to look elsewhere for more favorable hunting areas."

Endangered species which occur in the general area of the watershed or which migrate through the area include the red-cockaded woodpecker, bald eagle, and the American alligator. The ivory-billed woodpecker was at one time found in the area but is now probably extinct. None of the above species are known to inhabit the watershed. The watershed is not within the range of the red wolf.

Recreational Resources

Excellent water-based recreation and camping facilities are located at several nearby lakes. These are B.A. Steinhagen Lake, 13,700 surface acres, 14 miles west of Jasper; Sam Rayburn Reservoir, 144,000 surface acres, 10 miles north of Jasper; and Toledo Bend Reservoir, 181,000 surface acres, 25 miles east of Jasper. The water quality is good in these three reservoirs and is expected to remain so.

The Angelina and Sabine National Forests, with a combined area of 330,000 acres, are 15 miles north of Jasper. These public recreational areas are utilized heavily by both the local citizens and people from surrounding areas.

Archeological and Historical Values

There are no historic sites listed or in the process of nomination to the National Register of Historic Places. There are no known archeological resources of significance within the watershed.

Soil, Water, and Plant Management Status

The watershed is dominated by forestland, which comprises over 85 percent of the total land area. Extensive changes in land use are not anticipated. However, the development of tracts less than ten acres in size for home sites is expected to increase in the future.

There are 35 farm and forest industry units located wholly or partially within the watershed. Ten resource conservation plans, covering 17,076 acres, or 68 percent of the watershed, have been developed in cooperation with the Jasper-Newton Soil and Water Conservation District. Assistance on forest management is also provided to land users by the Texas Forest Service and the U. S. Forest Service.

Conservation plans developed by land users in consultation with resource personnel assisting the Soil and Water Conservation District are the basis for most land treatment measures. Conservation plans contain soil, water, and other needed inventories, data on critical conservation problems, and a record of decisions which have been agreed upon to reach conservation

objectives. The length of time required to fully implement a plan is contingent upon many factors, including: available labor, capital, materials, and time.

Forestland owners can be provided with a range of management alternatives for their lands. The Texas Forest Service, in cooperation with the U.S. Forest Service, is available to help landowners develop forest management plans for these and other forestlands under existing and active cooperative forest management programs. Forest management practices include: tree planting and stand improvement measures for the enhancement of the water-related capabilities of the forest, and other forest uses including wood products, wildlife habitat, recreational resources, esthetics, and climatic influences.

Watershed timber volumes per acre average about 2,600 board feet of saw timber and 300 cubic feet of pulpwood. These volumes are significantly below the potential production which could be realized with improved forestland management.

Land treatment measures which have been applied to date at an estimated expenditure of $582,320 (table 1A) by land users amount to about 67 percent of the projected total treatment needed. Soil surveys have been completed for the entire watershed.

WATER AND RELATED LAND RESOURCE PROBLEMS

Land Management

Land treatment on forestlands owned or controlled by lumber companies is directed to maximum sustained timber production. Clear cutting in blocks and pine reforestation has been the most common type of management on tracts controlled by these companies. Burning is sometimes practiced following cutting. Erosion is higher following cutting for a period of about two years. Re-establishment of timber stands provides soil cover and reduces erosion to a minimum until the trees reach a marketable age and the cycle is repeated. Twelve to fifteen years is required for pine seedlings to reach a marketable size. Future forest management programs designed to meet watershed needs will receive priority. Tree planting and stand improvement are land treatment measures planned for implementation. Some bottomland areas have a high water table which limits their potential for some timber species such as pine.

Land treatment measures applied on small farms within the watershed have been limited due to inadequate financial resources of land users and high initial cost of treatment measures per acre.

Soils within the watershed require moderate to high inputs of fertilizer for sustained production of crops. Low fertility limits production on many improved pastures and requires high inputs of fertilizer. Current availability and cost of fertilizer limits its application on pastureland.

Floodwater Damage

An estimated 1,095 acres of the watershed, excluding stream channels, is flood plain. This is the area that would be inundated by a 100-year frequency flood. The present flood plain land use is as follows: forestland, 59 percent; pastureland,3 percent; and miscellaneous uses including the City of Jasper, public roads, and railroads, 38 percent.

Flooding occurs frequently in portions of the watershed causing minor damages to agricultural properties and major damages to urban properties. Major floods, inundating more than half of the flood plain, occur on the average of once every two to three years. Minor floods, inundating less than half of the flood plain, occur on the average of two or three times a year. Cumulative totals of recurring flooding show an average of 859 acres flooded annually during the evaluation period.

There are 15 owners and operators who have experienced floodwater damage on agricultural land in the flood plain. In the urban portion of the flood plain there are 40 residential units and 30 commercial units that would be subject to flood damage from the 100-year frequency flood.

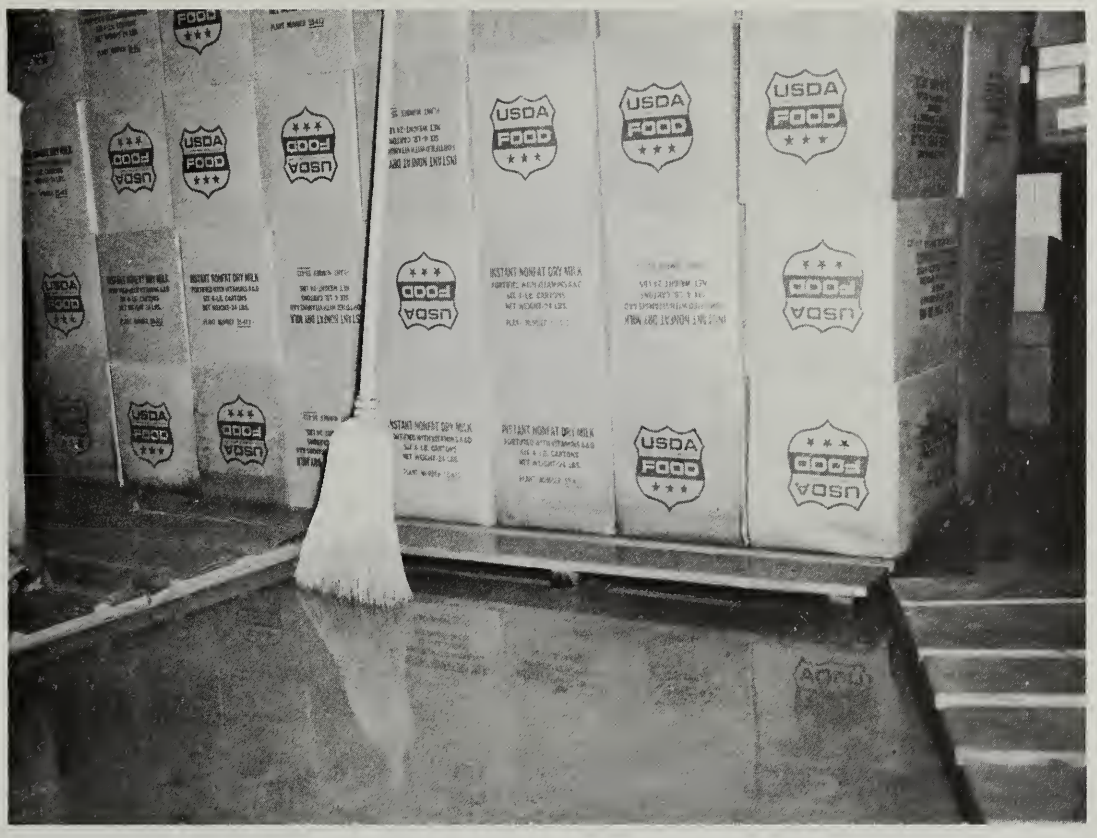
The small frequent floods have a nuisance effect on the property owners and residents within the watershed. Floodwaters from small floods overflow the natural streambanks and overflow portions of the flood plain creating swamping conditions ideal for vector breeding habitat. These floods have a disruptive effect to both landowners and commercial timber enterprises.

The flood plain of Sandy Creek within Jasper is subject to frequent flooding. Properties in the flood plain reflect a high percentage of commercial development. Most of the residential property in the flood plain of Sandy Creek is composed of moderate to low value units. These residential units are subject to more frequent damage than most of the business properties within the flood plain. For the past 10 to 20 years, developments within the flood hazard areas have been considerably less than in other areas of Jasper. Because of the flood threat, owners are reluctant to upgrade their homes and businesses because of fear of greater flood losses.

The most damaging flood in recent years occurred February 9-10, 1966. The total rainfall recorded at Jasper was 10.0 inches. 1/ The recurrence interval of the resulting flood peak was estimated to be about 17 years. The resulting flood inundated approximately 755 acres of flood plain in the watershed, of which 265 acres are located inside the urban area of Jasper. Under the present level of development, direct monetary floodwater damage from such a flood is estimated to be $59,940, of which $59,610 would be to urban properties.

Other recent large floods that caused considerable floodwater damages occurred in 1969, 1967, and 1964.

1/ Climatological Data, U.S. Department of Commerce, Environmental Science Services Administration, Environmental Data Service, Volume 71 No.2



Floodwater damage to Government commodities stored in warehouse. Note highwater mark on boxes.

(Photograph courtesy of the Jasper News-Boy Inc.)

Floodwater damage to commercial property.

4-33994 REVISED 3-75
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(Photograph courtesy of the Jasper News-Boy Inc.)

Floodwater damage to streets and utilities.

(Photograph courtesy of the Jasper News-Boy Inc.)

Looking south across Sandy Creek at intersection of Fletcher and East Houston streets. Floodwater damage to residential property.

Estimated direct floodwater damages to existing urban properties that would result from a 100-year frequency flood event are estimated at $326,180.

For the floods evaluated, which includes floods up to and including the 100-year frequency, total direct floodwater damage is estimated to average $89,630 annually (table 5). Of this amount, $80 is pasture damage, $70 is road and bridge damage, and $89,480 is urban development. Of the damage to urban properties, $67,800 is to commercial property, $9,920 to residential property, and $11,760 to city streets and utilities.

Erosion Damage

The average annual gross erosion rate is 4.8 tons per acre. Sheet erosion accounts for about 99 percent of this rate. The remaining one percent is contributed by streambank erosion, gully erosion, flood plain scour, and erosion from urban areas.

The sandy and silty soils in the watershed present considerable potential for severe upland erosion if fire, disease, or gross mismanagement of forestlands cause a reduction in canopy and ground cover for a significant period of time. About 40 percent of the forestland is grazed by cattle and hogs. Hogs are causing some erosion by their feeding habits on 2,200 acres. The hogs, although few in number, roam over the area. Wildfires burn an average of 0.50 percent of the forestland annually. These damages account for the major portion of the soil loss from the forested lands on the watershed. Land treatment measures with necessary maintenance and management are essential in controlling erosion on the watershed.

Sediment Damage

Sand, silty sand, and clayey sand have slowly accumulated during past years in stream channels and on the flood plain. This deposition has caused choking of natural channels, the water table to rise in some areas, and has increased the frequency of flooding. These deposits have also been a factor in depreciating stream channel fish habitat. Swamping in the area between Valley Sections S4 and S6 (figure 1) has been aggravated by sediment deposition.

Present sediment damage, in monetary terms, within the watershed is minor. The nature of the deposition, configuration of the flood plain, types of soils, and land use are factors limiting damages to the productive capacity of the flood plain. Because of obviously limited damages, detailed flood plain investigations and monetary evaluations, in regard to presently occurring sediment damage, were not made.

It is estimated that 33,740 tons of sediment are yielded annually to the lower end of the watershed. Approximately 50 percent of this yield is considered to be available for bedload within the channel. In terms of sediment concentration in average annual runoff of about 35.56 centimeters (14 inches), this amounts to an estimated 430 milligrams per liter. The storage capacity of B.A. Steinhagen Lake is being depleted by an estimated 4.3 acre-feet annually by sediment derived from Sandy Creek watershed. The estimated average annual value of this damage is $1,200 (table 5).

Indirect Damages

Indirect damages such as interruption or delay of travel, rerouting of school buses and mail routes, disruption of forestry operations, business losses in the area, and similar losses are estimated to average $17,910 annually.

Municipal and Industrial Problems

The City of Jasper obtains its municipal and industrial water supply from wells located in the Jasper aquifer. Jasper's present 6,251 population and projected future population of 11,300 by 1992 can be adequately served with the existing system of wells. Water for additional population and development of heavy water-using industries can be met by developing additional wells.

Recreation Problems

Recreational opportunities from fishing in Sandy Creek are limited. This is due to the depressing effect of sediment accumulation and industrial waste in the stream channel on the variety of fish species and their population.

Recreational facilities on B.A. Steinhagen, Sam Rayburn, and Toledo Bend Reservoirs; Angelina and Sabine National Forests; and any that would be developed in Sandy Creek watershed are located within the U. S. Department of Commerce, Office of Business Economics, Area 09133. The present population of this area is 394,703 and is projected to be 599,100 by the year 2,000.

There is no local interest in developing additional water-based recreation within the watershed.

Economic and Social Problems

Additional employment opportunities are needed for the 395 unemployed workers in the county. The population of Jasper increased from 4,889 persons in 1960 to 6,251 persons in 1970, an increase of 27.9 percent. Further increases in population could be anticipated with a concentrated effort in community development and additional employment opportunities.

PROJECTS OF OTHER AGENCIES

There are no existing or proposed water resource development projects of other agencies within the watershed.

B.A. Steinhagen Lake, completed in 1951 by the Corps of Engineers, is located on the Neches River about 10 miles below the watershed. Sandy Creek empties directly into the Reservoir. The lake provides 16,600 acre-feet of sediment storage and 77,600 acre-feet of conservation storage. There are no proposed reservoirs below the B.A. Steinhagen Lake, according to the Texas Water Plan.

In 1934, a portion of Sandy Creek, starting near Farm Road 776 and terminating near the city sewage treatment plant, was straightened and enlarged by a Civil Works Administration Project. Remnants of this project are nonexistent due to a lack of necessary easements allowing proper maintenance.

The works of improvement included in this plan will have no known detrimental effects on any existing or proposed downstream works of improvements, and will constitute a harmonious element in the full development of the Neches River basin.

PROJECT FORMULATION

Prior to the initiation of planning and during the planning phase, informational meetings were held. These meetings were conducted in the watershed by local sponsoring organizations. The initial meeting, held in Jasper, Texas, was attended by interested citizens, representatives of local organizations, and landowners. The purpose of this meeting was to determine public support for a watershed project before submitting an application for planning assistance to the Texas State Soil and Water Conservation Board.

The local organizing group identified watershed problems, located problem areas, and delineated the Sandy Creek watershed boundaries. This group determined that multiple sponsorship was needed to represent the diversity of interests within the watershed. The project would require cash outlays by the sponsoring local organization responsible for installation, operation, and maintenance of completed structural measures. They recognized it was essential that the proposed project have adequate sponsorship by qualified organizations. With public endorsement by those present, an application for planning assistance was prepared and submitted to the Texas State Soil and Water Conservation Board by organizations interested in sponsoring the application.

Subsequent to approval of the application, a field examination of Sandy Creek watershed was made by the Texas State Soil and Water Conservation Board and Soil Conservation Service to make an appraisal of the watershed problems, types of improvements necessary for watershed protection and flood prevention, the quality of human environment, and the effects of possible works of improvement on the environment. The findings of the field examination were publicly discussed at a meeting held for this purpose at Jasper, Texas.

A tour of Sandy Creek watershed and a public hearing was held by the Texas State Soil and Water Conservation Board in Jasper, Texas in May 1968. The tour and hearing provided assurance to the Board members that the watershed features were within the scope of Public Law 566; that existing watershed conditions warranted planning assistance; the public reaction was in support of a watershed project; and the sponsoring local organizations had the ability and willingness to fulfill future responsibilities for a watershed project. The Texas State Soil and Water Conservation Board approved the application with a high priority for planning assistance.

The Sandy Creek watershed application for assistance under Public Law 566, as amended, was authorized for planning by the Administrator of the Soil Conservation Service in February 1970. The State Conservationist of the Soil Conservation Service, in his written notification of initiation of work plan development, solicited information and comments from 32 federal, state and local agencies that might have an interest in the project. Contacts were made with several agencies and individuals during planning to obtain information and assistance during the planning process.

The planning application for Sandy Creek watershed was made prior to the implementation of notification, Bureau of the Budget Circular A-95, however the sponsors provided the Deep East Texas Development Council of Governments with notification of intent to apply for a project involving federal funds prior to the start of field planning operations.

Representatives of the Texas Forest Service and the U.S. Forest Service made reconnaissance studies of the watershed and provided recommendations and goals for implementation for land treatment measures on forestland in the watershed.

Representatives of the U.S. Fish and Wildlife Service, U.S. Department of Interior, and the Texas Parks and Wildlife Department made joint studies with biologists from the Soil Conservation Service. They described the fish and wildlife resources in the project, the effects of the project, and recommendations for maintaining, and enhancing the fish and wildlife resources of the watershed.

Representatives of Southern Methodist University made an archeological assessment on the six planned floodwater retarding structure sites.

Texas State Health Department representatives were contacted during the planning process to obtain their expressions in regard to the present and the future plans for improving the Jasper sewage treatment plant and the effluent releases.

Newspapers serving the watershed area published articles announcing public meetings and reported information and conclusions resulting from the meetings. In addition, the individuals whose land was directly involved with proposed works of improvement were notified and invited on an individual basis to attend meetings.

Meetings with the sponsoring local organizations and the steering committee were held during the planning process to coordinate, exchange information, evaluate alternatives, and reach agreements on a system of measures that would serve the needs of the people and the watershed resources.

Objectives

Reconnaissance studies were made by representatives of the Soil Conservation Service and sponsoring local organizations to determine watershed problems and possible solutions. There is a history of frequent flood damage to business, residential, and railroad properties; city streets; and utilities in Jasper and to agricultural properties along Sandy Creek and its tributaries.

Meetings were held to reach agreement on water, recreational, fish and wildlife, human, and watershed resource development needs. Desires of sponsoring local organizations were discussed, and initial project objectives were formulated.

The following specific objectives were agreed to:

1. Establish land treatment measures which contribute directly to watershed protection and flood prevention. Included is the application of measures by the end of the five-year project installation period that will adequately protect soil, water, and plant resources. The goal is to increase the establishment of needed land treatment measures from the present 62 percent to 90 percent by the end of the project installation period. These resources are considered to be adequately protected when their deterioration, either natural or caused by man, is effectively curtailed.

2. Attain as large a reduction in average annual flood damages to agricultural properties above and below the City of Jasper as feasible with due considerations to effects upon the forest environment, wildlife, existing improvements, and topography.

3. Attain a 90 to 95 percent reduction in average annual flood damages to the urban properties in Jasper with consideration given to the 100-year frequency storm.

In addition to the afore mentioned objectives, the U.S. Forest Service, working with the Texas Forest Service, has recommended and the sponsoring local organizations agree with the following goals and plans for implementation of land treatment measures on forestland in the watershed:

1. Stand improvement work will be accomplished on 3,800 acres by manipulation of stand composition and improvement cutting to obtain optimal production and protection of litter, humus, and forest cover.

2. Tree planting will be applied on 1,500 acres of open land to reduce storm runoff and erosion by developing a protective cover on an absorbent forest floor of a spongy humus layer under a protective layer of litter.

3. Develop an accelerated fire prevention and fire suppression program to reduce the number of fires which occur and the acreage burned each year. This will allow timber stands to develop a protective layer of litter and humus to improve hydrologic conditions and enhance wildlife habitat, timber production and other uses.

Environmental Considerations

The sponsors considered the impacts, both favorable and adverse, in developing the plan for meeting the project objectives. The objectives selected were those that would contribute to the conservation, development, and productive use of the watershed's soil, water, and related resources so that the watershed residents can enjoy:

QUALITY IN THE NATURAL RESOURCE BASE FOR SUSTAINED USE

QUALITY IN THE ENVIRONMENT TO PROVIDE ATTRACTIVE, CONVENIENT, AND SATISFYING PLACES TO LIVE, WORK, AND PLAY

QUALITY IN THE STANDARD OF LIVING BASED ON COMMUNITY IMPROVEMENT AND ADEQUATE INCOME

The sponsors selected measures which would help to achieve those objectives and included measures to minimize adverse impacts where practicable.

The condition of the soil and the growth it supports have a marked influence on the quality and quantity of water contributed by a watershed. The use of various control measures and management practices in this watershed is essential to conserve water resources and to prevent economic losses to municipal, industrial, and agricultural water supplies; fisheries; and recreation. In carrying out the various functional activities on watershed lands, including grazing of livestock and game, logging, road building, fire control, sewage disposal, and recreation, it is essential that watershed conditions be preserved and/or improved.

Land treatment measures planned for the watershed are those that will contribute directly to the preservation and enhancement of the environment in the watershed. Emphasis will be given to those measures which will reduce soil and water losses, assure proper functioning of the structural measures, reduce flooding, and preserve and improve the fish and wildlife resources of the watershed.

The U.S. Fish and Wildlife Service in cooperation with the Texas Parks and Wildlife Department and the Soil Conservation Service conducted a field survey of the watershed. Evaluations were made concerning the project impacts on fish and wildlife and recommendations were given to conserve or improve fish and wildlife resources. This report was carefully considered in formulating the project plan. Practices which will reduce or minimize wildlife habitat losses are included in the plans for structural measures. The land treatment phase includes practices designed to retain or improve existing fish and wildlife habitat.

During work plan development, studies were made by the sponsoring local organizations and the Service to minimize the displacement or relocation of individuals, farm and businesses. There are no apparent relocations or displacements that will be caused by installation of the project.

Alternatives

The considered alternatives to the proposed project action were: (1) a program of applying land treatment for watershed protection; (2) land treatment and flood plain zoning; (3) land treatment and floodproofing; (4) land treatment and flood insurance; (5) land treatment and relocation; (6) land treatment and a combination of flood plain zoning, floodproofing, and relocation; (7) land treatment and channel work; and (8) foregoing the implementation of a project.

A discussion of each alternative follows:

Alternative No. 1 - Alternative No. 1 consisted of applying land treatment measures as proposed in the project action. Average annual floodwater, sediment, and indirect damages would be reduced from $108,740 to $102,170, or a reduction of 6.0 percent. Depth of flooding from the one percent chance flood event would be reduced in the urban area of Jasper approximately 0.2 foot. The volume of sediment delivered annually to the mouth of the watershed would be reduced from 16 acre-feet to 9 acre-feet, a reduction of 44 percent. The adverse impacts that would be caused by installation of the floodwater retarding structures would be eliminated. The estimated cost of this alternative would be $159,210.

Alternative No. 2 - Alternative No. 2 consisted of land treatment and flood plain zoning.

The city of Jasper would restrict new construction or any major modification within the flood hazard area by zoning. This would prevent flood problems from increasing, but would not alleviate the existing problem. Floodwater and indirect damages to urban properties would continue at an average rate of about $100,000 annually. This alternative would eliminate the loss of wildlife habitat resulting from project installation while allowing the continued deterioration of natural and human resources caused by the floodwaters.

Alternative No. 3 - Alternative No. 3 consisted of land treatment and floodproofing.

Detailed studies of each residential or commercial unit to determine the structural feasibility of each unit was not practical. However, a general review of each property in relation to the flood depths that would have to be protected against indicated that 33 residential units and 16 commercial units could possibly be floodproofed satisfactorily. The cost of such floodproofing is estimated to be about $410,000. This alternative would alleviate the major damages to units floodproofed. Floodproofing of seven residential units and 14 commercial units would not be practical because of structural stability and design or excessive flood depths that would have to be protected against. Damages to streets, highways, water and sewer mains, and other vital utilities would remain the same. Average annual floodwater and indirect damages remaining under this alternative would be about $55,100. This alternative would eliminate the

loss of wildlife habitat resulting from project installation, but would allow much of the deterioration of natural and human resources caused by flooding to continue. Estimated total cost of this alternative is $569,210.

Alternative No. 4 - Alternative No. 4 consisted of land treatment and flood insurance.

Flood insurance could be made available to reduce the economic impact to an individual or business. However, flood insurance will not reduce the existing losses; it simply spreads them out over a larger segment of society and for a longer period of time. In the long run the total costs to society are probably higher because of the added cost of administration.

Alternative No. 5 - Alternative No. 5 consisted of land treatment and relocation of all residential and commercial property out of the flood hazard area.

The city of Jasper could purchase all property within the 100-year flood prone area and relocate all homes and businesses. The estimated cost would be about $2,700,000. It would be impractical to relocate streets, railroads, bridges, water and sewer lines and other utilities. Average damages to such public properties would still remain at about $14,100 annually. As in other nonstructural alternatives, the commitment of resources required for project measures would be eliminated. However, the relocation of 70 residential and commercial units would require a commitment of an undetermined acreage of land and habitat resources. The estimated total cost of this alternative is $2,859,210.

Alternative No. 6 - Alternative No. 6 consisted of a combination of land treatment measures, flood plain zoning, floodproofing, and relocation.

The City would zone the flood hazard area to prevent any new construction or major modification. An estimated 49 residential units could be floodproofed. The City would purchase and relocate seven residential and 14 commercial units outside of the flood hazard area. This would eliminate all major damages to residential and commercial property. Damages to public properties would continue to average about $14,100 annually.

The requirement of land and habitat resources needed for project installation would be eliminated as well as the adverse impacts directly attributable to the commitment of required resources. The relocation of 21 residential and commercial units would require the commitment of an undetermined acreage of land and habitat resources.

The cost of this alternative is estimated to be $1,479,210, of which $159,210 is for land treatment, $400,000 is for floodproofing, and $910,000 is for relocation.

Alternative No. 7 - Alternative No. 7 consisted of applying land treatment and channel work. The land treatment measures would be the same as in the proposed action. The channel work would consist of increasing the capacity of 2.9 miles of the main stem Sandy Creek channel through the urban area of Jasper. The channel would require concrete lining due to slope gradients, capacity requirements, and expected channel velocities.

The concrete lining would eliminate the fishery habitat on 2.9 miles of stream. Fish and wildlife habitat would be lost on about 70 acres of land.

This channel work would require about 70 acres of land through the urban area, and the replacement or modification of four bridge crossings, one railroad bridge, and numerous utility installations. The channel work would not reduce flooding on the agricultural flood plain. The estimated cost of this alternative is $7,527,260, consisting of $159,210 for land treatment and $7,368,050 for channel work.

Alternative No. 8 - Alternative No. 8 consisted of foregoing the implementation of a project.

Foregoing any type of project action would result in continued flood damage to urban and agricultural areas. There would be a reduction in priority of technical assistance to watershed land users which would delay the installation of land treatment. This would have an adverse effect on forestland ecosystems and reduce the ability of these systems to support timber production for lumber and wood products industries. Wildlife resources could also be adversely affected. It is reasonable to expect, however, that land users would eventually implement land treatment to maintain the productivity of their lands. Erosion and resultant sediment deposition would continue. The deterioration of the flood plain from sediment deposition and resultant high water tables would continue until the cumulative effects of this damage forced land use conversion to even less productive uses.

The need to use 636 acres of land required to construct the floodwater retarding structures and modified floodway would be eliminated.

The creation of 62 acres of surface water which could be used for fish and waterfowl resting habitat would be foregone.

The opportunity to realize about $50,950 in average annual net benefits would be foregone.

Priority in the selection of floodwater retarding structure sites was given to those which had the greatest potential for providing an acceptable level of flood protection with a minimum amount of adverse impact on the natural environment. Potential site locations and preliminary layouts were reviewed with the project sponsors. Alternate locations were investigated and comparisons made to determine the most feasible system of structural measures to obtain the sponsors' objectives.

Ten floodwater retarding structure locations were evaluated. Included were site locations on Trotti Creek, an unnamed tributary north of Jasper, and two alternates to the site selected on Fourmile Creek.

The location of the Gulf, Colorado, and Sante Fe Railroad precluded locating a flood water retarding structure on main stem Sandy Creek above Farm Road 776. The railroad is adjacent to the flood plain of Sandy Creek for almost the entire length of the watershed. Excessive cost for the railroad relocation makes this site unfeasible from an economic standpoint.

The project, as formulated, will meet project objectives in providing the desired level of protection to flood plain lands at least cost and commitment of natural resources.

Alternatives for similar watershed protection and flood prevention in the watershed without the technical and financial assistance provided under the authority of Public Law 566 are nonexistent at the present time. The burden of funding the planning and construction entirely from local financing would preclude the initiation of such a project.

WORKS OF IMPROVEMENT TO BE INSTALLED

Conservation Land Treatment

Conservation of soil, water, plant, and wildlife resources is the basic element of a flood prevention and watershed protection project. Treatment and use of land within the watershed largely determines the degree to which conservation objectives are attained. The function and useful life of structural measures such as dams and floodways are directly dependent upon the adequacy of conservation measures applied to the upstream land resource.

Needed land treatment measures are applied by individuals and others who own or directly control land within the watershed. Local project sponsors have limited control of land acquired by formal easements that will be directly affected by installation of structural measures. This land constitutes a small part (2.55 percent) of the total watershed.

In addition to effectively maintaining those land treatment measures already established (table 1A), it is planned to establish or complete the installation of needed land treatment measures on about 5,300 additional acres of forestland and 200 acres of pastureland (table 1) during a five-year installation period.

With the installation of the planned land treatment, 90 percent of the watershed will be adequately treated. Adequately treated land is land used within its capability on which the conservation measures and practices that are essential to its protection and planned improvement have been applied.

Properly managed upland pasture of coastal bermudagrass.

Woodland improvement measures applied to undesirable trees for the release and proper growth of young pine trees.

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Conservation land treatment applied and to be applied in this watershed will be on privately owned lands. The land user will make the decision on the use of his land and the treatment measures which he will install on his lands.

Soil surveys, which are essential to sound planning and application of land treatment measures, have been completed for the watershed. A soil survey is the classification, mapping, correlation, and interpretation of various types of soils in an area. Soils are classified considering their physical, chemical, and mineralogical characteristics. The classified soils are located and outlined on a map or aerial photograph of the area being surveyed, and correlated to determine the relationship of the various soils in the area to one another and to similar or identical soils identified in other areas. Soil survey interpretations indicate the limitations and suitability of a soil for selected uses.

Conservation measures that will be applied on pastureland include the planting or seeding of adapted species of perennial forage plants and their management for long-term production and use. Brush management will be applied on about 100 acres of pastureland. Brush management involves the selective control of noxious woody species to reduce competition and allow the establishment of desired vegetation. If herbicides are used for brush control, only those approved and authorized under current standards and regulations will be recommended.

Forestland which is utilized by domestic livestock will be properly grazed. Proper grazing use involves the utilization of forage species at an intensity which will assure their continued growth and survival.

Planned conservation land treatment to be installed and maintained on forestland includes tree planting in understocked stands and stand improvement measures. Stand improvement measures include the release of tree planting, natural regeneration release, and improvement cut. These measures are designed to improve stand composition and hydrologic conditions.

Landowners and operators will be encouraged to plan and establish land treatment that will maintain wildlife habitat. Plantings of woody and seed bearing vegetation on suitable areas such as idle or eroded lands, along fence rows, and around stock ponds will be encouraged. Landowners and operators will be encouraged to seek the advice of the Texas Parks and Wildlife Department or the U.S. Fish and Wildlife Service on stocking and managing of fish in farm ponds. These measures can contribute to supplemental farm income from the sale of hunting and fishing leases.

Fire is a constant threat to the timber and water resources of the watershed. The Cooperative Forest Fire Control Program will continue in the watershed and surrounding area to prevent destruction of resources by fire.

Landowners and operators will continue to install and maintain measures needed in the watershed following the project installation period.

Structural Measures - Floodwater Retarding Structures

A floodwater retarding structure is an earth dam or embankment with a principal spillway and plunge basin, an emergency spillway, a floodwater retarding pool, and a sediment pool. The function of the embankment is to temporarily impound floodwater upstream in the retarding pool. The water in the retarding pool flows, during a predetermined period, through the principal spillway which is a concrete vertical inlet and a conduit through the base of the embankment. Principal spillway flow is released into a plunge basin on the downstream side of the embankment. The plunge basin dissipates the energy of the principal spillway flow. The emergency spillway is designed to convey runoff that exceeds the planned capacity of the floodwater retarding pool past the embankment and back to the stream channel. The sediment pool is capacity below the principal spillway elevation allocated for storage of sediment expected to accumulate during a 100-year period.

A system of six floodwater retarding structures will be constructed in the Sandy Creek watershed. The locations of the floodwater retarding structures to be installed are shown on the Project Map (figure 5).

The six planned floodwater retarding structures will detain an average of 8.30 inches of runoff from 11.98 square miles of drainage area. These structures will control runoff from approximately 31 percent of the total watershed. The total storage capacity of the floodwater retarding structures is 5,643 acre-feet, of which 339 acre-feet are for sediment storage and 5,304 acre-feet are for floodwater retarding storage.

All structures are designed with sufficient sediment storage capacities to provide 100-year project life. All planned structures will store both submerged and aerated sediment. Principal spillway crests of all structures will be set at the elevation of the 100-year sediment pools.

The principal spillways will not require porting below the crest elevation because the 200 acre-feet impoundment limitation, with borrow volume included, will not be exceeded in any of the individual structures. Texas Water Rights Statutes require impoundments in excess of 200 acre-feet be permitted by the Texas Water Rights Commission.

There will be 278 acre-feet of sediment storage capacity provided below the lowest ungated principal spillway openings of the floodwater retarding structures.

All of the structures will have provisions to release impounded water in order to perform maintenance, and if it becomes necessary, to avoid encroachment upon prior downstream water rights.

Major problems which will materially affect construction of floodwater retarding structures are not anticipated. Some minor design considerations to be encountered include streamflow, high water table in the sediment pool area requiring some borrow above this elevation, sandy noncohesive soils in the emergency spillway, and lack of on-site rock riprap material for the plunge basin.

All the emergency spillways will be excavated in materials having a high potential for erosion in both the control and exit channel sections. Additional floodwater detention capacity has been added to all floodwater retarding structures to reduce both the size and frequency of operation of the emergency spillways and to minimize forestland disturbance. These volumes of storage capacities are equal to the volume of runoff of the emergency spillway hydrographs and exceed minimum requirements. The percent chance of use of all emergency spillways is 0.25.

Vegetation effective in controlling erosion will be established in the emergency spillway forebay and channel areas and embankment slopes. Areas which are vegetated will be fenced to protect them from overgrazing by domestic livestock.

Preliminary and present indications are that principal spillways will be on a compressible foundation. The principal spillways will have monolithic rectangular reinforced concrete inlets and prestressed concrete-lined, steel cylinder pipe outlet barrels. Rock or concrete lined plunge pools for all floodwater retarding structures are included in the preliminary details. Structural details will be treated in the final design phase.

The embankments will be earth fill with vegetative cover.

Ample and suitable earth materials for the six embankments are available within short haul distances. These materials consist of sandy and silty clay, clayey sand, and silty sand (CL, SC, and SM as classified in accordance with the Unified Soils Classification System). It is estimated that required emergency spillway excavation will provide about 30 percent of the needed embankment material for the six floodwater retarding structures. Emergency spillway excavation for floodwater retarding structure No. 2 is expected to yield a maximum of about 73 percent of the embankment fill, and emergency spillway excavation for floodwater retarding structure No. 4 will yield a minimum of 8 percent of the embankment fill. In addition to obtaining earth fill materials from required emergency spillway excavation, it may be necessary to obtain earth materials above sediment pool elevations due to high water table levels. Water table levels range from surface elevation to approximately five feet below the surface in the sediment pools and foundation areas of the floodwater retarding structures.

Foundation materials at all six floodwater retarding structure sites are characterized by permeable sandy and silty clay, and clayey and silty sand which will require foundation drainage measures. These materials are water saturated near the stream channels and adjacent flat and level areas. Special techniques may be required for the construction or installation of cutoff trenches, drainage trenches, or other seepage control measures. With the removal of surface materials and limited zones containing organic matter and debris, foundation materials possess sufficient bearing capacity and shear strength.

Streamflow conditions at each of the floodwater retarding structure sites is perennial. Flow volumes are considered to be large enough at each proposed site to maintain sediment pool impoundment levels at the principal spillway elevation.

The only increase of fertilizer within the watershed, as a result of project installation, will be that associated with the establishment and maintenance of the vegetation on dams, spillways, and disturbed areas. A maximum of 79 acres will be fertilized either for installation or maintenance. Only about half of the maximum acreage will be fertilized in any one year. The rate of fertilizer applied will be relatively low, only that necessary for the establishment or maintenance of cover. This very small increase of fertilizer use should not have any significant effect on the quality of any water resource within the watershed.

Installation of floodwater retarding structures will require change in location or modification of known existing improvements as follows:

Site No. 1 - none
Site No. 2 - county road
Site No. 3 - private fence
Site No. 4 - fences, water well, vacant house, and a garage
Site No. 5 - fences
Site No. 6 - private fence and a county road

All costs for necessary changes in location or modifications as listed above are land rights costs and will be borne by the sponsoring local organizations.

Under present conditions there will be no apparent displacements or relocations of persons, businesses, or farm operations as a result of installation of structural measures. If relocations or displacements become necessary, they will be carried out in accordance with Public Law 91-646, Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

Installation of the floodwater retarding structures will require 528 acres of land which includes 516 acres of forestland, 2 acres of open pastureland, and 10 acres of existing surface water impounding areas. The construction of dams and emergency spillways will require about 79 acres, of which all are forestland. The sediment pools at the crest of the principal spillways will inundate 69 acres, of which 60 acres are forestland, 2 acres are open pastureland, and 7 acres are existing impounded water acres. These pools will inundate about 2.2 miles of perennial stream channels. The retarding pools will require 380 acres, of which 377 acres are forestland and 3 acres are existing impounded water areas for temporary impoundment of floodwater. All needed borrow for the embankments can be obtained from the emergency spillway areas and from within the detention and sediment pool areas.

Approximately 139 acres will be cleared of existing woody vegetation for the construction of dams, emergency spillways, and sediment pools. Vegetation which will be removed consists of the following species and approximate acreages:

Thirty-three acres is typically a bottomland hardwood community adjacent to streams characterized by wet, seepy areas locally known as "spring heads" or "green heads". Vegetation consists of sweetbay, water oak *(Quercus nigra)*, blackgum, large gallberry, hazel alder *(Alnus serrulata)*, greenbriar *(Smilax spp.)*, red bay *(Persea borbonia)*, and american hornbeam *(Carpinus caroliniana)*.

Various shrubs, vines, sedges, and grasses occur in the understory of this community. About 2,100 acres of this community exist in the watershed.

Forty-four acres is a pine-hardwood community which is characteristically a transition zone between the bottomlands and uplands. Vegetation of this community typically consists of beech, sweetbay, magnolia, hickory *(Carya spp.)*, water oak, red oak *(Quercus falcata)*, red maple, ash, mulberry, and loblolly pine. Understory species include dogwood, hawthorns, elm, american beautyberry, yaupon, vines, sedges, and grasses. About 3,200 acres of this community exist in the watershed.

Sixty-two acres is an upland forest community which has been largely altered by burning, grazing, and commercial timber production practices. Soils are droughty and infertile sands. Much of this community has been clear cut and planted to loblolly pine. Vegetation which presently occupies this area consists of red oak, sandjack oak *(Quercus incana)*, hickory, blackjack oak *(Quercus marilandica)*, post oak *(Quercus stellata)*, loblolly pine, and longleaf pine. Pinehill bluestem and panicums are the primary grasses. About 16,000 acres of this community exist in the watershed.

The areas on which the six floodwater retarding structures will be installed presently serve as wildlife habitat for many species. The following actions, as formulated in the project, will be taken to reduce or minimize wildlife habitat losses:

1. The embankments will be seeded to a grass-legume mixture which could include lespedeza *(Lespedeza spp.)*, pensicola bahiagrass *(Paspalum notatum var. saurae)*, or other species and varieties that will provide wildlife food and cover in addition to necessary erosion control.

2. Borrow pits; excavated, filled, or denuded areas in the emergency spillways; and all other disturbed areas above the sediment pool elevations will be planted to some desirable vegetation, such as Japanese honeysuckle *(Lonicera japonica)*, that can be established without excessive cost, produce essential erosion control, and be of benefit to wildlife. It is expected that some fertilization and maintenance will be required for proper establishment.

3. Water tolerant trees capable of surviving in water depths anticipated in the upper portions of the sediment pools will be left in place. Trees which impede the proper functioning of structures or which will require undue maintenance will be removed.

4. The six embankments and excavated or dunuded areas in the emergency spillways will be fenced to protect vegetation established for wildlife cover and erosion control. The location of fences will be determined during final design and construction to insure that the most advantageous alignment and placement is obtained.

5. Cleared and disturbed areas downstream and approaching the base of the embankments will be planted to a hardwood tree mixture which may consist of oak species, dogwood, blackgum, chinquapin, and yaupon. The selected species to be planted will be determined by prevailing site conditions. In no case, will trees be planted in such close proximity to the base of the embankments that future root development and encroachment would endanger or create undue maintenance problems to the structure or its appurtenances. As prevailing conditions allow, the plantings should approach a 12 foot by 12 foot spacing. They will be maintained at a 75 percent survival rate for the initial five years after construction.

6. Squirrel nest boxes will be placed in the retarding pools. These boxes will be constructed of cypress, redwood, or other durable material. A maximum of three boxes per acre of destroyed habitat will be installed.

   Food, particularly mast, is considered to be the most important limiting factor for squirrels. The degree to which these boxes will be utilized and their value in sustaining a squirrel population is not fully known. Biologists of the Soil Conservation Service will make a full evaluation of the utilization of the boxes after each system of boxes is installed. The Service will invite other interested agencies to jointly participate in the evaluation study. Results of this study will be made available to other organizations and individuals who may be interested in squirrel management.

In addition to the measures that will be accomplished as part of planned project measures, there are other measures that can be implemented by land users which will help maintain or enhance the fish and wildlife resources. The Jasper-Newton Soil and Water Conservation District, in cooperation with appropriate agencies, will provide technical assistance to land users in the application of the following measures:

1. Initial stocking of the impoundments formed by the floodwater retarding structures and management thereafter to maintain adequate populations of game fish. The Texas Parks and Wildlife Department will assist with this measure.

2. Management of all undisturbed land in the floodwater retarding pool areas after construction for mast producing hardwood trees.

3. Installation of wood duck nest boxes in or adjacent to the sediment pools where water tolerant trees are not removed at the rate of about 10 nest boxes per floodwater retarding structure.

4. Use of prescribed burning practices whereby burning is done during the late winter months and firebreaks are renovated in alternate years during the same period.

5. Use of "checker board" arrangements of 20 to 30 acre blocks for forestland management and treatment where economically feasible and prevailing conditions allow.

The recommended practices and measures included in the project were agreed upon by the U.S. Fish and Wildlife Service, the Texas Parks and Wildlife Department and the Soil Conservation Service, as a result of field investigations and studies by biologists from these agencies.

The minimum land rights required will be those necessary to construct, operate, maintain, and inspect the works of improvement; to provide for flowage of water in, upon, or through the structures; and provide for the permanent storage and temporary detention, either or both, of any sediment or water.

During construction of all structural measures, contractors will be required to adhere to strict standards set forth in a construction contract to protect the environment by minimizing soil erosion and water and air pollution. These standards will be in compliance with U. S. Department of Agriculture, Soil Conservation Service Engineering Memorandum 66, "Guidelines for Minimizing Soil Erosion and Water and Air Pollution During Construction." Excavation and construction operations will be scheduled and controlled to prevent exposure of extraneous amounts of unprotected soil to erosion and the resulting translocation of sediments. Measures to control erosion will be uniquely specified for each work site and will include, as applicable, use of temporary vegetation or mulches, diversions, mechanical retardation of runoff, and traps. Harmful dust and other pollutants inherent to the construction process will be held to minimum practical limits. Haul roads and excavation areas, and other work sites will be sprinkled with water as needed to keep dust within tolerable limits. Contract specifications will require that fuel, lubricants, and chemicals be adequately labeled and stored safely in protected areas, and disposal at the work site will be by approved methods and procedures. Clearing and disposal of brush and vegetation will be carried out in accordance with applicable laws, ordinances, and regulations in respect to burning. The contract will set forth specific stipulations to prevent uncontrolled grass, brush or forest fires. Disposal of brush and vegetation will be by burying, hauling to approved off-site locations, or controlled burning, as applicable.

Stringent requirements for safety and health in conformance with the Construction Safety Act will be included in the construction contract.

Necessary sanitary facilities, including garbage disposal facilities, will be located to prohibit such facilities from being a pollution hazard to live streams, wells, or springs in conformance with Federal, State, and local water pollution control regulations. Special provisions in the construction contract will incorporate by reference, and thereby make the contract provisions conform to "Safety and Health Regulations for Construction, Part I and Part II, "U.S. Department of the Interior, Bureau of

Reclamation. Soil Conservation Service guidelines that provide for the incorporating of the Bureau of Reclamation regulations into construction contracts are in the "Soil Conservation Service Administrative Services Handbook, Chapter 6". Conformance to all environmental control requirements will be monitored constantly by a construction inspector who will be on-site during all periods of construction operation.

Efforts will be made to avoid creating conditions which will increase populations of vectors which affect public health conditions. Prevention and control measures will be implemented, if needed, in cooperation with appropriate Federal, State, and local health agencies to suppress proliferation of vectors such as aquatic insects, terrestrial arthropods and rodents, etc.

The six floodwater retarding structures are scheduled to be constructed during three years of the five-year installation period. It is not anticipated that construction work on more than two floodwater retarding structures will be underway at the same time. This will minimize cumulative environmental effects resulting from construction activities.

All six impoundments in the sediment pools of the floodwater retarding structures have potential for providing public recreation on a very limited basis. Water surface areas will range from 9 to 13 acres. The accessibility of structures Nos. 1 and 3 will be restricted due to the lack of suitable roads to the sites. The six floodwater retarding structures will be constructed on private lands and the sponsoring local organizations presently have no plans for providing public access to them. Sponsors have given assurance that adequate sanitary facilities meeting local and state health standards will be provided if the impoundments in the sediment pools are used for recreational purposes.

Figure 2 shows a section of a typical floodwater retarding structure. Figures 3 and 3A include a general plan of a dam, emergency spillway, and reservoir; an embankment plan and profile; and a cross section of a zoned embankment typical of the type of floodwater retarding structure included in this work plan. Table 3 shows details on quantities and design features for each floodwater retarding structure.

All applicable state laws will be complied with in the design and construction of the structural measures as well as those pertaining to the storage, maintenance of quality, and use of water.

The watershed work plan has been coordinated with the Texas State Historical Commission and the National Park Service, USDI. An archeology survey of the floodwater retarding sites was conducted by the Department of Anthropology, Archeology Research Program, Southern Methodist University, under the direction of Mr. S. Alan Skinner as principal investigator. The survey indicated no evidence of Indian habitation in any of the reservoir areas. No evidence was found that archeological resources will be affected by construction and maintenance of the proposed structures.

However, if evidence of significant archeological features are observed before or during construction, the Secretary of the Interior will be

notified so he may have investigations carried out to evaluate and salvage, if warranted, the resources. This will be done in compliance with Public Law 86-523.

Structural Measure - Floodway

Channel stability investigations and studies were made to help determine the feasibility of excavating and enlarging the channel on main stem Sandy Creek and Little Sandy Creek within and near the corporate limits of the city of Jasper. These studies and investigations indicate that an excavated channel in the area would present stability problems of such a magnitude as to preclude it as a feasible structural increment necessary to provide the required level of protection for the City.

Channel bank and stream channel bedload materials in the area were sampled and tested. All samples were classified in accordance with the Unified Soils Classification System. Nine of the 20 channel bank samples were classified as clay and silt (CL, CL-ML, and MH) with plasticity indexes from 8 to 22. The remaining 11 samples were fine sand (SP, SM, and SC-SM) with little or no plasticity. All stream channel bedload samples were fine sand. Very sandy clay is also present in the flood plain in the vicinity of the Jasper city sewage plant (figure 5).

The stream channel and its banks within the city limits of Jasper are generally in a stable condition, exhibiting no indication of appreciable aggradation or degradation. The exception to this condition is where fallen trees and logs have lodged in the channel causing bank erosion and excessive channel bedload accumulations. The stream channel capacity is inadequate to contain and convey runoff. One-half or more of the flood plain in the area is unundated on the average of once every two to three years.

In lieu of an excavated channel, a modified floodway in combination with the six floodwater retarding structures, has been selected as the method for achieving satisfactory flood damage reduction in the city of Jasper. The floodway (figure 5) is designed to be approximately 14,100 feet in length and located along Sandy Creek, beginning at Station 144+00 near the northwest corner of the City sewer Plant, then progressing upstream to Station 285+00 at Farm Road 766. Little Sandy Creek floodway length will be approximately 1,200 feet beginning at Station 0+00 and ending at Station 12+00. The total floodway length is 15,300 feet or about 2.9 miles. The floodway will not generally be excavated or leveed, but will be developed by removing debris, dense underbrush, and small trees from the flood plain area up to 200 feet on each side of the channel (figure 4A). The minimum area required is 108 acres, all within the city of Jasper.

Hydraulic studies indicate that by lowering the "n" values (Mannings coefficient of roughness) to about 0.040 for the floodway area, a floodway approximately 400 feet wide would be sufficient to significantly improve the hydraulic characteristics of the flood plain by reducing the elevation of the 100-year flood event associated with the planned six floodwater retarding structures.

The 100-year flood event was selected for design of the floodway due to benefits accredited to urban properties. The 100-year design discharge was determined from flood routings, as outlined in Technical Release No. 20, for present and with project conditions. The floodway and the six floodwater retarding structures provides for a 100-year level of protection to existing structural properties within the urban area of Jasper.

Unusual problems are not anticipated in accomplishing the required clearing and maintenance of the floodway. However, from the city sewage plant and extending upstream about 1,400 feet, the flood plain area is too wet to facilitate clearing and proper maintenance. A surface lateral, to provide adequate surface drainage for this area, will be constructed during the initial phase of floodway development. This minimum size surface lateral will not have a formal channel design. The grade of this lateral will be less than .00075 feet per foot.

Within the floodway area approximately 108 acres of vegetation will be altered by the removal of understory vegetation. The overstory, which consists of oak, sweetgum, sweetbay, blackgum, red maple, beech, and baldcypress *(Taxodium distichum)*, will be largely retained. Understory species include large gallberry, dogwood, hawthorns, texas buckeye, american beautyberry, yaupon, holly, grape *(Vitus spp.)*, smilax, and sumac.

A canopy of mast producing and den-site trees most beneficial to wildlife and aesthetic values will be retained in the floodway area. Trees to be retained will be selected on the basis of good vigor and good full crown. Young healthy trees at least 8 inches in diameter are to be preferred to mature trees of low vigor. Beauty and diversity will be an important consideration in selecting trees to be retained. The floodway will have a park-like atmosphere. (Figure 4A) This will be accomplished by marking trees for retention prior to clearing operations. This retention of mature overstory species will assure that mast producing den-site locations remain. There will be adequate trunk spacing and low branches will be trimmed to allow use of maintenance equipment for control of undergrowth. Grass will be planted or other suitable ground cover established on sustaintial areas disturbed and denude during construction clearing operations.

The minimum land rights required for the floodway is 108 acres, all within the City of Jasper (figure 5). The floodway is expected to be installed during the second year of the project installation period.

There are no planned appurtenances to be constructed with the floodway. There are no alternations, modifications, or changes in location of existing improvements with installation of the floodway.

EXPLANATION OF INSTALLATION COSTS

Public Law 566 funds, in the amount of about $9,900, to be used by the U.S. Forest Service for technical assistance during the five-year installation period, will be provided to accelerate the application of forestland treatment for watershed protection. The Texas Forest Service will provide $1,900 for technical assistance and $2,500 as additional capital outlay under the Cooperative Forest Fire Control Program and will also provide additional services valued at $1,200 under the Cooperative Forest Management Program. Public Law 46 funds in the amount of about $8,810, will be used by the Soil Conservation Service to provide technical assistance under the going program. Local interests will apply the planned land treatment at an estimated cost of $140,300. The costs of applying the various measures are based on present prices being paid by landowners and operators in the area.

The total installation cost of the structural measures is estimated to be $901,180, of which $802,830 will be borne by Public Law 566 funds and $98,350 will be borne by local interests.

The Public Law 566 costs for installing the structural measures includes $644,830 for construction, $43,620 for engineering services, and $114,380 for project administration.

The local costs for project installation include $84,550 for the value of the land; $2,500 for county roads; $4,300 for fences, water well, house and garage; $3,000 for legal fees; and $4,000 for project administration.

Construction costs include the engineer's estimate and contingencies. The engineer's estimate was based on unit cost of structural measures in similar areas modified by special conditions inherent to the site locations. The costs of measures to reduce or minimize wildlife habitat losses are included as part of the structural measures. Ten percent of the engineer's estimate was added as a contingency to provide funds for unpredictable construction costs. No unusual construction problems are anticipated.

Engineering services and project administration costs were based on an analysis of previous work in similar areas. Engineering services costs consist of, but are not limited to, detailed surveys, geologic investigations and laboratory analysis, reports, designs, and cartographic services.

Public Law 566 project administration costs consist of construction inspection, contract administration, and maintenance of Soil Conservation Service records and accounts.

Local costs for project administration includes sponsors' costs related to contract administration, overhead and organizational administrative costs, and whatever construction inspection they desire to make at their own expense.

The value of land rights was determined by appraisal in cooperation with representatives of the sponsoring local organizations.

The following is the estimated schedule of obligations for the five-year installation period.

Schedule of Obligations

Fiscal Year	Measures	Public Law 566 Funds	Other Funds	Total
First	Land Treatment	2,000	30,942	32,942
Second	Land Treatment	2,000	30,942	32,942
	Floodway	84,560	28,250	112,810
Third	Land Treatment	2,000	30,942	32,942
	Floodwater Retarding Structures Nos. 3 and 4	226,310	25,400	251,710
Fourth	Land Treatment	2,000	30,942	32,942
	Floodwater Retarding Structures Nos. 1 and 2	267,070	22,400	289,470
Fifth	Land Treatment	1,900	30,942	32,842
	Floodwater Retarding Structures Nos. 5 and 6	224,890	22,300	247,190
TOTAL		812,730	253,060	1,065,790

This schedule may be changed from year to year to conform with appropriations, accomplishments, and any mutually desirable changes.

EFFECTS OF WORKS OF IMPROVEMENT

Flood Prevention, Erosion, and Sediment

The installation of the planned land treatment and structural measures will achieve the project objectives of watershed protection and flood prevention.

The application of the planned land treatment measures will improve the productivity of the soil by reducing erosion and improving the fertility and infiltration properties of the soil. The measures will also reduce downstream floodwater and sediment damages by reducing erosion and the peak rate of runoff from the upland.

Improved forest management and protection will allow an increase in litter accumulation and ground cover resulting in less erosion and improved future hydrologic conditions.

Owners and operators of flood plain land will be able to improve their management of flood plain lands, due to reduced flooding, by management practices necessary to reach optimum use of flood plain land. Underplanting and release to change tree species composition to a more desirable type and an improvement in stand composition will enhance the development of an absorbent, protective layer of humus and litter on forestland. Vigilant protection from fires will aid in retaining protective cover. The measures will also reduce downstream floodwater and sediment damages by the reduction of erosion and runoff from uplands. The recommended method of applying brush control in areas supporting wildlife populations will be to retain units and patterns of brush of good habitat value in favorable locations for use as browse and cover by wildlife. It is not expected that any of the flood plain land will be shifted from forestland or pastureland to cropland.

Application of the planned land treatment is expected to reduce annual gross erosion from 120,500 tons to 53,250 tons, a reduction of approximately 56 percent. The average annual sediment yield to the lower end of the watershed will be reduced from an estimated 16 acre-feet to 5 acre-feet as a result of the planned land treatment and structural measures. Suspended sediment, which is a pollutant and absorbs chemical pollutants such as pesticides, herbicides, fertilizers, etc., will be reduced in average annual runoff of 35.56 centimeters (14 inches) at the mouth of the watershed from an estimated concentration of 430 milligrams per liter to 150 milligrams per liter, a 65 percent reduction.

Sediment originating in the watershed and deposited in B.A. Steinhagen Reservoir will be reduced by an average of 2.8 acre-feet annually, a 65 percent reduction.

Monetary damages resulting from presently occurring deposition of sediment are minimal because of land use. However, sediment deposition on the flood plain and in stream channels will be reduced by about 65 percent. As a result, the rates at which swamping is occurring and channel capacities are being diminished will be reduced accordingly.

Installation of the project will have no measurable impact on ground water resources in the watershed.

The project will provide damage reduction to 1,095 acres of flood plain within the watershed and will benefit directly 15 owners and operators of agricultural flood plain land, the owners and occupants of 40 residential units, and the owners or operators of 30 business units in Jasper.

Average annual flooding will be reduced from 859 acres to 640 acres, a reduction of 26 percent. Reduction in area inundated varies with respect to location within the watershed. The general locations of the areas to be benefited as a result of reduced flooding, caused by the combined program of land treatment, structural measures, and floodway, are presented in the following tabulations:

Average Annual Area Inundated 1/

Evaluation Reach (figure 1)	Location	Without Project (acres)	With Project (acres)	Reduction (percent)
1	Sandy Creek below City of Jasper	121	101	17
2	Urban Area-City of Jasper	390	282	28
3	Sandy Creek above City of Jasper	338	254	25
4	Little Sandy Creek	10	3	70
TOTAL		859	640	26

1/ Based on cumulative totals of recurrent flooding expected to occur during the project evaluation period with consideration of floods up to and including the 100-year frequency event.

Area Inundated by Selected Recurrence Intervals

Evaluation Reach (figure 1)	Recurrence Interval: 2-Year Without Project (acres)	2-Year With Project (acres)	5-Year Without Project (acres)	5-Year With Project (acres)	25-Year Without Project (acres)	25-Year With Project (acres)	100-Year Without Project (acres)	100-Year With Project (acres)
1	74	63	92	77	109	91	117	101
2	231	192	255	198	353	223	410	242
3	239	180	363	264	491	358	536	435
4	6	0	14	5	25	13	32	19
TOTAL	550	435	724	544	978	685	1,095	797

Had the project been installed at the time of the February 9-10, 1966 flood, acres flooded would have been reduced from about 755 acres to 570 acres, a reduction of 25 percent. Direct monetary damages would have been reduced from an estimated $59,940 to $60, a reduction of over 99 percent.

Figure 4 shows the urban area of Jasper that would be inundated by a 100-year frequency flood without and with project conditions. The proposed project will provide flood-free protection from a 100-year frequency event to all existing urban properties except one house located next to Sandy Creek and several streets and utility crossings. The depth in the areas subject to continued flooding from the 100-year frequency flood with project conditions, is a maximum of 1.4 feet above the elevation where damage starts to existing developments with an average depth of approximately 0.5 foot. With the project installed, damages to urban properties from such a flood will be reduced from $326,180 to $5,910. The actions of people during time of floods, whether major or minor, cannot be predicted. However, with any reasonable precautions, the hazard to life from floodwaters will be eliminated. The disruption and relocation of residents during periods of flood threats will be virtually eliminated along with costs necessary for evacuation, emergency shelter, and relief operations.

The following tabulation shows effects of the project on flood damages by evaluation reaches. All figures indicate average annual reductions:

Average Annual Damage Reduction 1/

Evaluation Reach (figure 1)	Pasture (percent)	Non-Agricultural (percent)	Sediment (percent)	Total (percent)
1	22.2	-	-	22.2
2	-	99.3	-	99.3
3	-	87.5	-	87.5
4	No significant damages			
B.A.Steinhagen Lake	-	-	65.0	65.0
Weighted Average	22.2	99.3	65.0	98.9

1/ Reduction based on consideration of floods up to and including the 100-year frequency event.

Analysis of information collected indicated that no significant changes would be made in the use of agricultural land within the flood plain, either in the form of restoration of former productivity or in more intense use. There are no alloted crops and no changes are expected.

Indirect damage reduction benefits will accrue to the project. These benefits include the reduction or elimination of expenses associated with interruption or delay of travel, rerouting of school buses and mail routes, disruption of farming and forestry operations, business losses in the area, and similar losses.

During construction of the structural works of improvement, air and water pollution will increase slightly from dust and sediment inherent to the construction process. This increase will be kept within tolerable limits. At the end of construction and with the establishment of vegetation for erosion control, the dust and sediment increase intrinsic to construction operations will have completely subsided.

Fish and Wildlife and Recreation

The installed project is expected to improve fishery resources in the watershed. Land treatment measures will reduce detrimental sediment in streams. The sediment pools of the floodwater retarding structures are expected to provide about 62 acres of additional fish habitat. Proper stocking and management of these impoundments will enable them to provide a significant sport fishing resource.

Selective clearing in the floodway area will not affect existing fish habitat. The stream in the proposed floodway area is presently a poor quality habitat and supports a very small amount of sport fishing.

The impoundments in the sediment pools of the retarding structures will provide approximately 62 acres of additional resting habitat for migrating waterfowl. However, the same area which will be inundated, is presently good to excellent bottomland habitat for swamp rabbit, mink, and gray squirrel. The areas occupied by dams or cleared for emergency spillway and borrow excavation in the retarding pools will significantly alter the quality of approximately 79 acres of good to excellent wildlife habitat. Also, quality of wildlife habitat in the 108 acre area where the floodway is planned will be reduced. About 200 acres of grassland and 5,300 acres of forestland (table 1) are expected to receive land treatment during the five-year installation period. Measures that result in reduction in shrubs, vines, herbs, and forbs that provide food and cover will adversely affect wildlife. The Cooperative Forest Fire Control Program, which is included in the land treatment, can have an immeasurable effect in protecting and preserving wildlife populations and habitat, in addition to its primary purpose.

Archeological, Historic, and Scientific

There are no archeological or historic sites listed in or nominated to the National Register of Historic Places that will be affected by the

installation of measures included in the project. An archeology survey of the six floodwater retarding structure sites was conducted by the Department of Anthropology, Archeology Research Program, Southern Methodist University, under the direction of Mr. S. Alan Skinner as principal investigator. It was the opinion of the investigators that no archeological resources will be affected by the proposed floodwater retarding structures.

Economic and Social

Secondary benefits, from the installation of a complete project for flood prevention, will accrue in the trade area. The project will create additional employment for local residents. The firms contracting for installation of the floodwater retarding structures will employ some of their employees locally. The operation and maintenance of project measures will also provide employment for local residents.

During the construction stage of the proposed project, additional requirements for building materials, petroleum products, and other necessities will stimulate the economy. This construction will create approximately 31 man-years of employment, which will further strengthen the economy during this phase.

The reduction of damages by structural means will provide an impetus for a higher quality of living and social upgrading by watershed residents in the form of increased income to households will be realized by the local economy annually.

Additional intangible benefits will accrue to the project through the opportunity to shift public funds from the repair of damages to public roads and utilities to investment in schools and other public facilities that improve the quality of living. Likewise private funds now going to repair flood damage can be shifted to raising the standard of living of the residents in the affected area. The elimination or reduction of flooding will allow owners of residential and business units to upgrade their properties, thereby creating a more pleasant environment in which to live and work. Significant intangible public health benefits will accrue in the City of Jasper, including reduced hazards of loss of life and injury, elimination of health hazards associated with damage to water supply and waste disposal systems, improved vector control, and the prevention of other factors accompanying floods which tend to disrupt the maintenance of public health.

Other

The dedication of land for the construction and functioning of the floodwater retarding structures and floodway will contribute directly to reducing floodwater and attendant damages on flood plain lands and in the City of Jasper.

The floodwater retarding structures and floodway will require a total of 637 acres of land. The required 79 acres for dams and emergency spillways are all forestland. The sediment pools will need 69 acres, of which 60 acres

are forestland, two acres are pastureland, and seven acres are presently inundated. An additional 380 acres will be dedicated to the retarding pools. This area includes 377 acres of forestland and three acres of presently inundated area. The floodway will require 108 acres, all of which is within the City of Jasper.

After the sediment pools have impounded water to the principal spillway crest elevations, stream flow below the structures will not be significantly affected. The volumes of base flow in the streams under average climatic conditions are sufficient to cause the principal spillways to function continuously and allow similar flow downstream.

PROJECT BENEFITS

The estimated average annual monetary floodwater and indirect damages within the watershed will be reduced from $107,540 to $810. Including sediment damage in B.A. Steinhagen Lake, the damage will be reduced from $108,740 to $1,230, a reduction of 98.9 percent (table 5).

Benefits to landowners and operators from the planned land treatment measures were not evaluated in monetary terms since experience has shown that conservation practices produce benefits in excess of their costs.

Reduction in monetary flood damages vary with respect to locations within the watershed. The following tabulations show the general locations of damage reduction benefits attributed to the combined program of land treatment, structural measures, and floodway.

Evaluation: Reach (figure 1):	Location	Average Annual Damage: Without Project (dollars)	With Project (dollars)	Reduction 1/ (percent)
1	Sandy Creek below City of Jasper	90	70	22.2
2	Urban Area-City of Jasper	107,370	730	99.3
3	Sandy Creek above City of Jasper	80	10	87.5
4	Little Sandy Creek	Insignificant		
-	B.A. Steinhagen Lake (Sediment)	1,200	420	65.0
TOTAL		108,740	1,230	98.9

1/ Reduction based on consideration of floods up to and including the 100-year frequency event.

Direct Monetary Floodwater Damage at Present Level of Development

Evaluation Reach (figure 4)	Recurrence Interval: 2-Year Without Project (dollars)	2-Year With Project (dollars)	5-Year Without Project (dollars)	5-Year With Project (dollars)	25-Year Without Project (dollars)	25-Year With Project (dollars)	100-Year Without Project (dollars)	100-Year With Project (dollars)
1	60	50	70	50	100	70	110	90
2	3,030	0	47,770	0	167,370	2,450	326,180	5,910
3	0	0	200	0	430	190	510	330
4	Insignificant							
TOTAL	3,090	50	48,040	50	167,900	2,710	326,800	6,330

It is estimated that the project will produce local secondary benefits, which exclude indirect benefits in any form, averaging $8,380 annually. Secondary benefits from a national viewpoint were not considered pertinent to the economic evaluation.

COMPARISON OF BENEFITS AND COSTS

The total average annual cost of structural measures, floodway, and mitigation measures (amortized total installation and project administration cost, plus operation, maintenance, and replacement) is $58,370. These measures are expected to produce total average annual benefits of $109,320, resulting in a benefit-cost ratio of 1.9:1.0 (table 6).

The ratio of total average annual benefits, excluding secondary benefits, accruing to structural measures and floodway ($100,940) to the average annual cost of these measures ($58,370) is 1.7:1.0.

PROJECT INSTALLATION

Landowners and operators will establish planned land treatment (table 1) in cooperation with the Jasper-Newton Soil and Water Conservation District. The Soil Conservation Service, the U.S. Forest Service and the Texas Forest Service will cooperate with the Jasper-Newton Soil and Water Conservation District to provide technical assistance in planning and installing land treatment measures.

Educational meetings will be held in cooperation with other agencies to outline services available. The Extension Service will assist in this phase of the program by preparing press, radio, and television releases; by conducting general information meetings; and by using other methods of informing landowners and operators.

An estimated 62 percent of needed soil and water conservation practices have been applied. The goal is to increase the level of land treatment application to at least 90 percent of total needs during the installation period.

In reaching this goal, it is expected that application of the additional land treatment will progress as shown in the following tabulation:

Land Use	Units	Fiscal Year 1st	2nd	3rd	4th	5th	Total Acres
Pastureland	Acres	40	40	40	40	40	200
Forestland	Acres	1,060	1,060	1,060	1,060	1,060	5,300
Total	Acres	1,100	1,100	1,100	1,100	1,100	5,500

The governing body of the Jasper-Newton Soil and Water Conservation District will assume aggressive leadership in getting the land treatment program underway. Land users will be encouraged to apply and maintain soil and water conservation measures on their farms. In addition, land users where floodwater retarding structures will be located, will be encouraged to apply and maintain measures for the enhancement of wildlife. The Soil Conservation Service will provide technical assistance in the planning and application of soil, plant, and water conservation measures. A forester will be assigned through the Cooperative Forest Management Program to assist land users in the installation of forestry practices.

Special emphasis will first be placed on getting a higher degree of land treatment in the drainage areas of floodwater retarding structures. Then the emphasis will be on drainage areas not controlled by structures.

The Extension Service will assist with the educational phase of the program by providing information to landowners and operators in the watershed.

The City of Jasper has the right of eminent domain under applicable state law and has the financial resources to fulfill its responsibilities and agrees to use such authority and funds, if necessary, to acquire all land rights needed for project installation.

The Soil Conservation Service, in compliance with a request from the sponsors, will be the contracting agency and will provide the necessary administrative and clerical personnel; facilities, supplies, and equipment to advertise, award, and administer contracts. The City of Jasper will represent sponsoring local organizations in coordination with the Soil Conservation Service on matters concerning construction.

The City of Jasper will have the following responsibilities pertaining to the six planned floodwater retarding structures and the floodway:

1. Obtain the necessary land rights

2. Provide for the change in location or modification of fences and other privately owned improvements necessary for installation of the six floodwater retarding structures and approximately 2.9 miles of floodway.

3. Provide for the necessary improvements to low water crossings on public and private roads below the floodwater retarding structure to make them passable during prolonged release flows from the structure or provide equal alternate routes for use during periods of inundation; and

4. Determine and certify legal adequacy of easements and permits for construction of structural measures.

Technical assistance will be provided by the Soil Conservation Service in preparation of plans and specifications, construction inspection, preparation of contract payment estimates, final inspection, execution of certificate of completion, and related tasks necessary to install the planned structural measures.

The six floodwater retarding structures and the floodway will be constructed during the second, third, fourth and fifth years of a five-year project installation period in the general sequence that follows:

Second Year - Floodway
Third Year - Floodwater Retarding Structures Nos. 3 and 4
Fourth Year - Floodwater Retarding Structures Nos. 1 and 2
Fifth Year - Floodwater Retarding Structures Nos. 5 and 6

In order for construction to proceed according to schedule, all land rights for the floodwater retarding structures and the floodway will be secured by the City of Jasper by the end of the periods as shown in the following tabulation. The schedule will begin when the work plan is approved for operations.

Time Period	Works of Improvement
First six months	Floodway
Second six months	Floodwater Retarding Structures Nos. 3 and 4
Third six months	Floodwater Retarding Structures Nos. 1 and 2
Fourth six months	Floodwater Retarding Structures Nos. 5 and 6

FINANCING PROJECT INSTALLATION

Federal assistance for carrying out works of improvement described in this work plan will be provided under authority of the watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress; 68 Stat. 666).

The cost of applying land treatment measures will be borne by landowners and operators. Funds provided under the going program (Public Law 46) and Public Law 566 funds will be used for technical assistance in planning and applying soil and water conservation measures. The Public Law 566 funds will be used for the acceleration of planning and application of these

measures. The U.S. Forest Service will also offer technical assistance and provide capital outlay under the Cooperative Forest Fire Control Program. The Texas Forest Service will provide assistance under the Cooperative Forest Management Program. Cost-share assistance for application of conservation measures is available through the Rural Environmental Conservation Program which is administered by the Agricultural Stabilization and Conservation Service of the United States Department of Agriculture.

The cost of technical assistance furnished by the Soil Conservation Service, U.S. Forest Service, and the Texas Forest Service during the five-year installation period is estimated to be $21,810. This consists of $9,900 to be provided from Public Law 566 funds which will be used by the U.S. Forest Service; $3,100 of Texas Forest Service funds and services, of which $1,200 will be from the going Cooperative Forest Management Program; and $8,810 of Public Law 46 funds that will be used by the Soil Conservation Service.

Funds for the local share of the cost of this project relative to structural measures will be provided by the City of Jasper. The City of Jasper has analyzed its financial needs and has the financial ability to make arrangements to carry out their responsibilities. The City's share of the installation cost will come from current City revenues and funds previously set aside for installation of the project.

It is anticipated that approximately 90 percent of the number of easements required for the installation of the floodwater retarding structures will be donated. Out-of-pocket costs for land rights, legal expenses, and project administration are estimated to be $18,530 for floodwater retarding structures and $28,250 for the floodway.

Public Law 566 funds for installation of structural measures will not be provided until the City of Jasper institutes a form of flood plain zoning to preclude further urban expansion in the designated floodway area (figure 4). The City will enact a zoning ordinance to regulate future urban expansion in the area between the 100-year with project elevation and the designated floodway (figure 4). This restriction will not preclude developments in this area outside of the floodway on landfill or raised foundations to elevations exceeding the 100-year with project water level. The City will determine and furnish the minimum acceptable elevation as shown on figure 4 before construction starts on any new development.

The structural measures will be constructed during the second, third, fourth, and fifth years of a five-year project installation period pursuant to the following conditions:

1. Requirements for land treatment in the drainage area of the floodwater retarding structures have been satisfied.

2. All land rights have been obtained for all structural measures, or a written statement is furnished by the City of Jasper that its right of eminent domain will be used, if needed, to secure any remaining land rights within the project installation period and that sufficient funds are available for purchasing them.

3. Flood plain zoning ordinances or regulations have been enacted.

4. Operation and maintenance agreements have been executed.

5. Project agreements have been executed.

Financial and other assistance to be furnished by the Soil Conservation Service is contingent upon the appropriation of funds for this purpose.

Various features of cooperation between the cooperating parties have been covered in appropriate memorandums of understanding and working agreements.

The soil and water conservation loan program sponsored by the Farmers Home Administration is available to eligible landowners and operators in the area. Present FmHA clients will be encouraged to cooperate in the program.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land Treatment Measures

Planned land treatment measures will be maintained by landowners and operators of farms and forestlands on which measures are applied under agreement with the Jasper-Newton Soil and Water Conservation District. Representatives of the District will periodically survey the status of land treatment and provide technical assistance to land users in the performance of needed maintenance.

Structural Measures

The City of Jasper will be responsible for operation and maintenance of the structural measures. Funds will come from a $15,000 reserve fund maintained by the City for this purpose. This will be financed by a budgeted line item in the City's annual budget.

A specific operation and maintenance agreement, in accordance with provisions of the Soil Conservation Service Operations and Maintenance Handbook of Texas, will be executed prior to signing a project agreement for the construction of structural measures. Precise provisions for retention and disposal of property acquired or improved with Public Law 566 financial assistance will be included in the agreement. A specific operation and maintenance plan will be prepared for each structural measure.

The effectiveness of the floodway in providing the planned level of protection to urban properties is dependent upon a high and consistent level of maintenance. The surface lateral will require frequent inspection and maintenance throughout the project life to insure that it will remain open at all times so that maintenance of the floodway can be performed when needed.

Maintenance of the floodway will be most critical in the first five years of operation. Control of vegetation will require frequent maintenance during the first few years to prevent the rapid return and increased density of undergrowth. Maintenance will be performed by mechanical and hand operation to control vegetation to a low retardance type of growth and to maintain a park-like atmosphere within the floodway.

The estimated average annual cost of operation and maintenance of the floodway is $3,000. For the first few years of operation, maintenance will be greater than $3,000, but with early and intense control of regrowth this amount should decrease. The estimated average annual cost of operation and maintenance for the six floodwater retarding structures is $2,010. The average annual cost of operation, maintenance, and replacement of mitigating measures will be $230.

All measures to reduce or minimize wildlife habitat losses, as outlined in the work plan, are considered as integral parts or as appurtenances to the structural measures and will be maintained accordingly.

Sponsors will control the handling, use, and application of any herbicides and pesticides that may be needed for operation and maintenance of structural measures. If the use of chemicals should be required, only approved and authorized reagents and compounds will be used. Their application will be compatible with current laws regulating their use. In addition to prudent judgement, ordinances and standards concerned with the disposal or storage of unused chemicals, empty containers, contaminated paraphernalia, etc., will be observed and applied.

The floodwater retarding structures, measures to reduce or minimize wildlife habitat losses, and floodway will be inspected at least annually and after each heavy rain by representatives of the City of Jasper and the Jasper-Newton Soil and Water Conservation District. A Soil Conservation Service representative will participate in these inspections for a period of at least three years following construction. The Soil Conservation Service will participate in inspections as often as it elects to do so after the third year. Items of inspection will include, but are not limited to, conditions of the principal spillway and its appurtenances, the emergency spillway and the earth embankments for the floodwater retarding structures; general conditons and usefulness measures to reduce or minimize wildlife habitat losses, and degradation and aggredation of the channel and flood plain area and conditon of undergrowth on the floodway. A written report will be made of each inspection. A copy of each report will be provided by the City of Jasper to the Jasper-Newton Soil and Water Conservation District and to the designated Service representative within ten days of the date on which the inspection was made.

Upon completion of each floodwater retarding structure by the contractor, subject to the establishment of vegetation, the City of Jasper will assume responsibility for maintenance of the structure. They will perform promptly, or have performed promptly, all maintenance of the structure as determined to be needed by either the sponsors or the Service, including that required to prevent soil erosion and water pollution.

The Soil Conservation Service will participate in operation and maintenance only to the extent of furnishing technical assistance to aid in inspections and technical guidance and information necessary for the operation and maintenance program.

Provisions will be made for unrestricted access by representatives of the sponsoring local organizations and the Soil Conservation Service to inspect all structural measures and their appurtenances at any time and for sponsoring local organizations to perform operation and maintenance. Easements insuring this unrestricted ingress and egress will be furnished by the sponsoring local organizations.

The City of Jasper will maintain a record of all maintenance inspections made, maintenance performed, and cost of such maintenance and have it available for inspection by Soil Conservation Service personnel. The necessary maintenance work will be accomplished by contracts, force accounts, or be sponsoring local organizations using their own equipment.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST
Sandy Creek Watershed, Texas

Installation Cost Item	Unit	Number Non-Federal Land	Estimated Cost (Dollars) 1/ P.L. 566 Funds Non-Federal Land S.C.S. 3/	P.L. 566 Funds Non-Federal Land F.S. 3/	P.L. 566 Funds Total	Other Funds Non-Federal Land S.C.S. 3/	Other Funds Non-Federal Land F.S. 3/	Other Funds Total	TOTAL
LAND TREATMENT									
Land Areas 2/	Acres								
Pastureland	to be	200	-	-	-	23,000	-	23,000	23,000
Forestland	treated	5,300	-	-	-	-	117,300	117,300	117,300
Fire Control	-	-	-	-	-	-	2,500	2,500	2,500
Technical Assistance 4/		-		9,900	9,900	8,810	3,100	11,910	21,810
TOTAL LAND TREATMENT		-	-	9,900	9,900	31,810	122,900	154,710	164,610
STRUCTURAL MEASURES									
Construction									
Floodwater Retarding Structures 5/	Number	6	578,830	-	578,830	-	-	-	578,830
Floodway (M) 6/	Miles	2.9	66,000	-	66,000	-	-	-	66,000
Subtotal - Construction			644,830	-	644,830	-	-	-	644,830
Engineering Services			43,620	-	43,620	-	-	-	43,620
Project Administration									
Construction Inspection			57,190	-	57,190	2,000	-	2,000	59,190
Other			57,190	-	57,190	2,000	-	2,000	59,190
Subtotal - Administration			114,380	-	114,380	4,000	-	4,000	118,380
Other Costs									
Land Rights			-	-	-	94,350	-	94,350	94,350
TOTAL STRUCTURAL MEASURES			802,830	-	802,830	98,350	-	98,350	901,180
TOTAL PROJECT			802,830	9,900	812,730	130,160	122,900	253,060	1,065,790

1/ Price Base: 1974
2/ Includes only areas estimated to be adequately treated during the project installation period. Treatment will be accelerated throughout the watershed, and dollar amounts apply to total land areas, not just to adequately treated areas.
3/ Federal agency responsible for assisting in installation of works of improvement
4/ Includes $1,200 from going cooperative Forest Management Program
5/ Includes measures to reduce or minimize wildlife habitat losses
6/ Type of channel prior to project: (M) - Previously modified

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

(at time of work plan preparation)

Sandy Creek Watershed, Texas

Measures	Unit	Number Applied to Date	Total Cost (Dollars) 1/
LAND TREATMENT			
Brush Management	Acre	500	50,000
Pasture and Hayland Management	Acre	400	10,000
Pasture and Hayland Planting	Acre	500	20,000
Proper Grazing Use	Acre	3,000	1,500
Tree Planting	Acre	3,000	90,000
Woodland Improvement	Acre	15,121	342,420
Road Construction	Miles	11.2	56,000
Landline Maintenance	Miles	100	10,000
Cooperative Forest Fire Control Program	Acre	3,100	2,400
TOTAL			582,320

1/ Price Base: 1974

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TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION
Sandy Creek Watershed, Texas
(Dollars) 1/

Item	Installation Cost P. L. 566 Funds			Installation Cost Other Funds		Total Installation Cost
	Construction	Engineering	Total PL-566	Land Rights	Total Other	
Floodwater Retarding Structures						
1	110,090	6,610	116,700	9,400	9,400	126,100
2	107,480	6,450	113,930	12,000	12,000	125,930
3	91,850	6,430	98,280	11,600	11,600	109,880
4	89,350	6,250	95,600	12,800	12,800	108,400
5	90,770	6,350	97,120	10,500	10,500	107,620
6	89,290	6,250	95,540	10,800	10,800	106,340
Subtotal	578,830	38,340	617,170	67,100	67,100	684,270
Floodway	66,000	5,280	71,280	27,250	27,250	98,530
Subtotal all Structural Measures	644,830	43,620	688,450	94,350	94,350	782,800
Project Administration			114,380		4,000	118,380
GRAND TOTAL	644,830	43,620	802,830	94,350 2/	98,350	901,180

1/ Price Base: 1974

2/ Includes $2,300 for change in location or modification of fences, $2,500 for county roads, $1,000 for water well, $500 for vacant house, $500 for a garage, and $3,000 for legal fees.

TABLE 3 - STRUCTURAL DATA

STRUCTURES WITH PLANNED STORAGE CAPACITY

Sandy Creek Watershed, Texas

Item	Unit	Structure Number 1	2	3	4	5	6	Total
Class of Structure		C	C	C	C	C	C	xxx
Drainage Area (Total)	Sq. Mi.	1.88	2.19	1.88	2.62	1.67	1.74	11.98
Controlled	Sq. Mi.	1.88	2.19	1.88	2.62	1.67	1.74	11.98
Curve No. (1-day)(AMC II)		59	59	59	59	59	59	xxx
Elevation Top of Dam	Ft.	368.4	328.9	289.1	334.0	287.3	274.4	xxx
Elevation Crest Emergency Spillway	Ft.	363.2	324.3	284.2	328.2	282.6	269.9	xxx
Elevation Crest Principal Spillway	Ft.	340.7	297.5	261.8	301.9	263.3	250.5	xxx
Elevation Crest Lowest Ungated Outlet	Ft.	340.7	297.5	261.8	301.9	263.3	250.5	xxx
Maximum Height of Dam	Ft.	41	45	37	44	33	34	xxx
Volume of Fill	Cu. Yd.	118,100	102,600	94,700	93,800	86,300	81,000	576,500
Total Capacity	Ac. Ft.	888	1,018	892	1,224	795	826	5,643
Sediment (100-year)	Ac. Ft.	56	48	60	64	55	56	339
Sediment Submerged 1/	Ac. Ft.	46	40	49	53	45	45	278
Sediment Aerated	Ac. Ft.	10	8	11	11	10	11	61
Sediment Pool (Lowest Ungated Outlet)	Ac. Ft.	46	40	49	53	45	45	278
Retarding Pool	Ac. Ft.	832	970	832	1,160	740	770	5,304
Surface Area								
Sediment Pool (Lowest Ungated Outlet)	Acres	12	9	13	13	11	11	69
Sediment Pool - Principal Spillway Crest	Acres	12	9	13	13	11	11	69
Retarding Pool	Acres	70	73	76	83	75	72	449
Principal Spillway Design								
Rainfall Volume (areal) (1-day)	In.	15.2	15.2	15.2	15.2	15.2	15.2	xxx
Rainfall Volume (areal) (10-day)	In.	25.5	25.5	25.5	25.5	25.5	25.5	xxx
Runoff Volume (10-day)	In.	13.0	13.0	13.0	13.0	13.0	13.0	xxx
Capacity (Maximum)	cfs	108	117	105	113	102	105	xxx
Frequency Operation-Emergency Spillway	% chance	0.25	0.25	0.25	0.25	0.25	0.25	xxx
Size of Conduit	In.	30	30	30	30	30	30	xxx
Emergency Spillway Design								
Rainfall Volume (ESH) (areal)	In.	14.2	14.2	14.2	14.2	14.2	14.2	xxx
Runoff Volume (ESH)	In.	8.30	8.30	8.30	8.30	8.30	8.30	xxx
Storm Duration	Hrs.	6	6	6	6	6	6	xxx
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	xxx
Bottom Width	Ft.	150	200	150	150	150	150	xxx
Velocity of Flow (V_e)	Ft./Sec.	0	0	0	0	0	0	xxx
Slope of Exit Channel	Ft./Ft.	0.1285	0.1177	0.052	0.064	0.035	0.042	xxx
Maximum Water Surface Elevation	Ft.	362.1	322.9	283.1	327.0	281.7	268.8	xxx
Freeboard								
Rainfall Volume (FH) (areal)	In.	31.7	31.7	31.7	31.7	31.7	31.7	xxx
Runoff Volume (FH)	In.	24.64	24.64	24.64	24.64	24.64	24.64	xxx
Storm Duration	Hrs.	6	6	6	6	6	6	xxx
Maximum Water Surface Elevation	Ft.	368.4	328.9	289.1	334.0	287.3	274.4	xxx
Capacity Equivalents								
Sediment Volume	In.	0.56	0.41	0.60	0.46	0.62	0.60	xxx
Retarding Volume	In.	8.30	8.30	8.30	8.30	8.30	8.30	xxx

1/ Includes volume in sediment pool (Lowest ungated outlet)

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TABLE 3A - STRUCTURE DATA

FLOODWAY

Sandy Creek Watershed, Texas

Channel Name	Station 1/	Drainage Area Sq. Mi.	Capacity cfs 2/ Required	Capacity cfs 2/ Design	Water Surface Elev. 2/	Floodway Dimensions 2/ Hydraulic Gradient (ft./ft.)	Floodway Dimensions 2/ Cross Sectional Area (sq. ft.)	Floodway Dimensions 2/ Wetted Perimeter (ft.)	"n" Value Aged	"n" Value As Built	Velocities ft./sec. 2/ Aged	Velocities ft./sec. 2/ As Built	Type of Work 3/	Before Project Type of Channel 4/	Before Project Flow Condition 5/
Sandy Creek	163+05	29.54	3,100	3,100	197.0	.0017	1,410	820	.040	.040	2.6	2.6	III	M	Pr
	175+20	29.16	2,930	2,930	198.1	.0004	2,440	1,115	.040	.040	1.7	1.7	III	M	Pr
	190+65	28.84	2,940	2,940	201.5	.0010	1,730	970	.040	.040	1.9	1.9	III	M	Pr
	202+15	28.65	2,900	2,900	202.7	.0004	2,230	985	.040	.040	1.8	1.8	III	M	Pr
	228+15	27.89	2,780	2,780	207.0	.0007	1,635	735	.040	.040	2.0	2.0	III	M	Pr
	237+10	27.50	2,640	2,640	208.3	.0011	1,260	575	.040	.040	2.5	2.5	III	M	Pr
	260+75	24.82	2,250	2,250	211.7	.0009	1,185	520	.040	.040	2.3	2.3	III	M	Pr
	271+85	19.12	1,780	1,780	213.9	.0012	890	450	.040	.040	2.3	2.3	III	M	Pr

1/ Stream Stationing - Begin floodway at Station 144+25 End floodway at Station 284+90

2/ 100 Year Frequency

3/ III-Clearing of flood plain (removal of high retardance vegetation)

4/ M (1934) - Previously modified channel

5/ Pr - Perennial - flows at all times except during extreme drought

TABLE 4 - ANNUAL COST

Sandy Creek Watershed, Texas

(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost 2/	Operation and Maintenance Cost	Total
Floodwater Retarding Structure Numbers 1 through 6 and Floodway	46,150	5,240	51,390
Project Administration	6,980		6,980
GRAND TOTAL	53,130	5,240	58,370

1/ Price Base: 1974

2/ 100-Years at 5.875 percent interest

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE

REDUCTION BENEFITS

Sandy Creek Watershed, Texas

(Dollars) 1/

Item	Estimated Average Annual Damage: Without Project	With Project	Damage Reduction Benefits
Floodwater			
Pasture	80	60	20
Nonagricultural 2/			
Road and Bridge	70	10	60
Urban			
Commercial Property	67,800	0	67,800
Residential Property	9,920	240	9,680
Streets and Utilities	11,760	370	11,390
Subtotal	89,630	680	88,950
Sediment			
B. A. Steinhagen Lake	1,200	420	780
Indirect	17,910	130	17,780
TOTAL	108,740	1,230	107,510

1/ Price Base: Agricultural damages current normalized prices; other damages 1974

2/ Evaluation of damages resulting from floods up to and including a 100-year frequency event. Floods larger than the 100-year frequency event still will cause additional damage after project installation.

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TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Sandy Creek Watershed, Texas

(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS 1/			Average Annual Cost 2/	Benefit Cost Ratio
	Damage Reduction	Secondary	Total		
Floodwater Retarding Structure Numbers 1 through 6 and Floodway	100,940	8,380	109,320	51,390	2.1:1.0
Project Administration				6,980	
GRAND TOTAL	100,940	8,380	109,320	58,370	1.9:1.0

1/ Price Base: Agricultural benefits current normalized prices; other benefits 1974

2/ From Table 4

3/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of $6,570 annually.

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INVESTIGATIONS AND ANALYSES

Land use and Treatment

The land treatment portion of the project was developed after a systematic survey of the watershed was made to determine the general ground cover and hydrologic conditions and the additional need for conservation land treatment practices and measures. The survey, supporting data, and information from other agencies and forestry officials were used to determine the needed measures that would not be installed by the going programs. The effects of needed measures on fire hazards were analyzed, and their effectiveness in minimizing erosion and reducing flooding was considered. The forestland treatment needs were then adjusted to meet the expected land users participation in the program during the five-year installation period and included in the work plan.

Detailed hydrologic soil and cover conditions were determined by using a representative 20 percent sample of the watershed and considering the amount of effective ground cover and litter in absorbing and retarding potential runoff. Future conditions were estimated on the basis of the expected percentage of needed land treatment applied during the installation period and probable effectiveness in further development of desirable litter and ground cover.

Hydraulics and Hydrology

Hydrologic soil and cover conditions were determined by detailed mapping of 20 percent of the watershed.

Present hydrologic cover conditions were determined on the basis of the percentage of vegetative ground cover and litter. Future hydrologic cover conditions were estimated on the basis of expected percentage of needed land treatment to be applied during the installation period and the probable effectiveness of the application.

Rating curves were developed for present and with project conditions, by water surface profiles as outlined in The South Regional Technical Service Center, Automatic Data Processing Input Manual, from surveyed valley cross sections located in joint consultation by the hydraulic engineer, economist, and geologist.

Project formulation, hydrology, was developed for present and with project conditions using rainfall data from U.S. Weather Bureau Technical Paper No. 40 and Soil Conservation Service hydrologic routing procedures as outlined in Technical Release No. 20.

Water surface profiles and project formulation hydrology were developed by automatic data processing using the computer at the South Regional Technical Service Center, Fort Worth, Texas.

The frequency method for evaluation was used to develop damages for present and with project conditions. Area and depth inundation tables and curves for both urban and agricultural areas were developed from water surface profile data.

Engineering

Studies were made in the agricultural areas of the flood plain and in the urban area of Jasper to locate those areas subject to flood damage.

A floodwater retarding structure site on the unnamed tributary immediately north of Jasper and west of U.S. Highway 96 was investigated. Studies showed that the drainage area of this site is 0.96 square mile and that a floodwater retarding structure at this location would not provide significant reduction in peak flows on Sandy Creek.

More comprehensive surveys and investigations were made of a possible floodwater retarding structure site on Trotti Creek. The confluence of Trotti Creek with Sandy Creek is in the lower portion of the benefited flood plain. The limited area that would have benefited from this structure did not effect a favorable benefit-cost relationship. For the above reasons, these sites were not included in the final work plan.

Six floodwater retarding structures were selected for inclusion in the final work plan. The structure locations are shown on figure 4. Table 3 provides specific site information.

Sediment and floodwater storage, structure classification, and emergency spillway layout and design meet or exceed criteria outlined in Engineering Memorandum SCS-27.

A detailed investigation was made of state, county, and city road or street crossings below the floodwater retarding structures.

Multiple routings of both principal and emergency spillways were made to determine the principal spillway sizing, height of embankment, detention storage requirement, and to analyze the effects of release flows on downstream improvements.

Least cost studies of designs were made for the planned floodwater retarding structures. The costs of storing the emergency spillway hydrographs as the structures are designed were compared with the costs of a system of structures designed for minimum storage only. The study indicated that the average annual cost of the additional storage was $60 per site. This additional storage not only reduced the emergency spillway erosion potential and related maintenance, but it also increases the level of flood protection.

The 100-year frequency design discharge capacity for the floodway was computed by routings, for project conditions, using procedures outlined in Technical Release No. 20.

The floodway is planned for an "aged" and "as built" Mannings "n" value of 0.040. As described above, construction will be limited to a clearing and snagging type operation. The channel will remain in its present condition. No shaping or clearing will be done on the channel. The "n" values will remain the same for "as built" and "aged" conditions.

The design velocity, of the floodway, for the 10-year frequency event, with project conditions, varies from 1.2 feet per second to 2.2 feet per second.

The water surface profile for the 100-year flood was used to examine channel and floodway stability. The stream channel water surface elevation and velocity was determined for conditions with and without the project. The following tabulation shows the channel elevation and velocity resulting from a 100-year flood.

	Without Project		With Project	
Station	Elevation	Velocity	Elevation	Velocity
163+05	200.7	2.7	198.3	1.9
175+20	202.1	2.3	199.8	1.8
190+65	205.8	2.5	203.0	2.0
202+15	206.8	2.2	204.1	1.8
228+15	212.0	2.5	209.0	1.7
237+10	213.3	3.5	209.8	2.3
260+75	215.0	3.0	212.8	2.1
271.85	218.8	3.1	215.2	2.6

The project would reduce the velocity of the existing stable channel. Because of the varied hydraulic parameters of the channel,the allowable velocity analysis could not be made. It was reasoned, however that the presently stable channel would remain stable with the decreased velocity.

The designed velocity, of the floodway, for the 10-year frequency event, with project conditions, varies from 1.2 feet per second to 2.2 feet per second.

Geology

Soils and Foundations

Preliminary geologic investigations were made at each of the floodwater retarding structure sites to obtain information on the nature and extent of embankment and foundation materials, types of material in emergency spillway excavation, emergency spillway stability, depth to the water table, and

other problems that might be encountered during construction. These investigations included surface observations of valley slopes, alluvium, channel banks, exposed geologic formations, and hand auger borings. Geologic maps and reports pertaining to the watershed and vicinity were studied. The floodwater retarding structure sites are located on geologic formations as follows:

Site No. 1 - Willis Formation
Site No. 2 - Fleming and Willis Formations
Site Nos. 3, 4, 5, and 6 - Fleming Formation

Descriptions of the geologic formations are included under "Environmental Setting" and details concerning foundation conditions are in the "Works of Improvement to be Installed" section.

Sedimentation

Sedimentation investigations were made in accordance with procedures as outlined in N.E.H., Sec. 3, Technical Release No. 17, "Geologic Investigations for Watershed Planning", March 1966, and Technical Release No. 12, "Procedure-Sediment Storage Requirements for Reservoirs", January 1968.

Determination of the sediment storage requirements for the six planned floodwater retarding structures were made according to the following procedure.

Detailed studies of soils, slopes, and cover were made within the drainage area of three floodwater retarding structure sites.

Average annual sheet erosion, for present and future conditions, was computed using the soil loss equation by Musgrave. Estimates of average annual sheet erosion within the drainage areas of the other three sites were based on the computed erosion rates.

Computations of gully and streambank erosion were based on estimated lateral bank erosion rates, bank heights, and channel lengths affected by erosion.

Sediment delivery ratio and trap efficiency adjustments were applied to computed average annual erosion to arrive at an estimate of the sediment volume to be deposited in floodwater retarding structures. Allowances were made for differences in density between submerged sediment and aerated sediment. These densities were based on estimated volume weights of 84 to 85 pounds per cubic foot for submerged sediment and 97 to 98 pounds per cubic foot for aerated sediment.

Allocation of deposition to the sediment pools and retarding pools of the floodwater retarding structures was based on sediment texture and reservoir topography, and allowances for differences in density between submerged sediment and aerated sediment. The allocation, by volume, ranges from 82 to 83 percent in the sediment pools and from 17 to 18 percent in the detention pools.

Reservoir Sedimentation

Erosion rate and sediment source studies in Sandy Creek watershed were used as a basis for estimating the effects of the project on sediment deposition in B.A. Steinhagen Lake. Sediment delivery ratios were estimated for non-project and installed project conditions, making allowances for factors such as size, shape, location, and topography of the sediment producing areas; density, drainage pattern, gradient, and capacities of channels; and volume-weight and texture of sediment.

The estimated average annual sediment yield to B.A. Steinhagen Reservoir from Sandy Creek watershed is four acre-feet. An average annual reduction of three acre-feet of sediment deposition in B.A. Steinhagen Reservoir is anticipated as a result of the establishment and proper maintenance of the planned land treatment and the construction of the six floodwater retarding structures in this work plan.

Channel Stability

Presently, the only areas of channel bank and stream bed showing appreciable erosion and aggradation are where logs, fallen trees, debris, etc. have lodged in the stream channel. After submitting 23 samples of channel bank and bed load materials to the Materials Testing Section in Fort Worth, Texas and obtaining pertinent data from analysis, stability studies were made using criteria in S.C.S. Technical Release 25.

It was determined that the cost of enlarging and improving a channel in the area that could reasonable be expected to be stable immediately after construction would be excessively high. The course of action planned in lieu of excavation and enlargement is to construct a floodway by removing debris, dense brush and small trees from the existing channel, channel banks, and flood plain area up to 200 feet on each side of the channel.

Bedload studies using the Schoklitsch bedload equation indicate the average annual storm with the installed and properly maintained project will cause slight aggradation within the channel in the lower portion of the watershed. The larger, less frequent storms are expected to cause a small amount of degradation, which should result in a relatively stable bedload condition over the life of the project.

Flood Plain Sediment and Scour Damages

Detailed sediment and scour damage investigations in the flood plain were not made. Due to the present and anticipated land use, nature of sediment, minimal occurrence of scour, soil types, and configuration of the flood plain, it was determined that presently occurring damages affecting the productive capacity of the flood plain are monetarily insignificant.

Economics

Basic methods used in the economic investigations and analyses are outlined in the "Economics Guide for Watershed Protection and Flood Prevention", U.S. Department of Agriculture, Soil Conservation Service, March 1964.

Because of the diversity of damageable values and flood plain characteristics, the flood plain was divided into four evaluation reaches (figure 1). Of these one was in the urban area of Jasper.

Determination of Nonagricultural Damages

Because the major floodwater damages in this watershed are to nonagricultural property, the frequency method of analysis was used. Information was collected in the field on damages experienced from the flood of February 1966 and from several other floods. At the same time an evaluation was made of the damages that would occur from a flood which could be expected on an average of once in 100-years. Under without project conditions, a flood of this magnitude would result in flood water elevations in Jasper of approximately 3.6 feet higher than the elevations recorded in 1966. High water marks from the experienced floods were used to determine peak stages which, in turn, were related to stages calculated for the evaluation series. Stage damage curves were developed to cover the range of damage producing floods. Average annual damages under the present state of development were calculated.

An analysis was made of existing data pertaining to the economic development of the Jasper area. In addition, data developed by the Office of Business Economics (OBE), U.S. Department of Commerce, for Area 09133, which includes the City of Jasper, was analyzed to determine the factors which have contributed to the overall growth of the area. Bank deposits were also considered. A comparison of pertinent historic data relative to economic activities in Jasper and the total OBE area indicates that population, per capita income, and the resulting total personal income for Jasper will increase at about the same rate or at a slightly faster rate than that projected for the OBE area.

The urban flood plain of Sandy Creek is subject to frequent flooding. Properties in the flood plain reflect a high percentage of business development. Future increased development in this area will be tied largely to increases in total personal income as business development is related to increases in the total population of an urban area and increases in per capita income. For this reason, it is believed that projections of total personal income best reflect the number and values of properties that would be subject to flood damage even in the absence of a project. Therefore, damage to the existing development was increased by 205.2 percent to reflect the gradual accrual of these values discounted to present worth.

Estimates of damages to city streets, roads, and highways in the flood plain were obtained from city, county, and state highway officials and supplemented by information from local residents.

Sediment damage to B.A. Steinhagen Reservoir was determined by the straight line method. Estimated construction costs were used to determine the cost per acre-foot of storage lost by sediment deposition.

Determination of Agricultural Damages

Agricultural damage calculations were based on information obtained from owners and operators of approximately 25 percent of the acreage in the flood plain. Schedules covered flooding and flood damage; past, present, and intended future use; and yield data. Verification of information gained in the field was obtained from local agricultural technicians.

Negative Project Benefits

Areas that will be used for project construction and the acres to be inundated by the reservoir pools were excluded from damage calculations. Net income from production to be lost in these areas after installation of the project was compared with the appraised value of the land amortized over the period of project life. An estimate was made, however, of the value of the production that would be lost in those areas after installation of the project. It was considered that all production would be lost in the areas to be dedicated to sediment pools. The land dedicated to the detention pools was assumed to be forestland under project conditions. The average annual net loss in production was calculated and compared with the amortized value of the land necessary for project installation. The amortized annual value of land exceeded the net value of production loss, and therefore, was used in project evaluation.

Indirect Damage Reduction Benefits

Expenses associated with disruption of agricultural and forestry operations, interruption of travel, rerouting of school buses and mail routes, business losses and similar losses will be incurred. Indirect damages were estimated to be 10 percent of pasture damages, and nonagricultural road and bridge damages; and 20 percent of the urban property damage.

Secondary Benefits

The value of local secondary benefits stemming from the project were estimated to be equal to 10 percent of direct primary benefits. This excludes all indirect benefits from the computation of secondary benefits.

Increased employment resulting from the proposed project was estimated by the use of multipliers as calculated in "An Input-Output Analysis of the Texas Economy Emphasizing Agriculture" by Lonnie L. Jones and Gholam Mustafa, Texas A&M University, November 1971.

Archeological

An archeology survey of the floodwater retarding structure site was conducted by the Department of Anthropology, Archeology Research Program, Southern Methodist University, under the direction of Mr. S. Alan Skinner as principal investigator.

The survey report stated that no evidence of prehistoric occupation was noted in the survey areas, confirming information from local artifact collectors that no sites are known to exist in this area. It was the

opinion of the investigators that no archeological resources will be affected by the proposed floodwater retarding structures.

Fish and Wildlife

The U.S. Fish and Wildlife Service, in cooperation with the Texas Parks and Wildlife Department, has completed a reconnaissance study of Sandy Creek watershed. This report was valuable in work plan development pertaining to fish and wildlife. Data presented in this report has been incorporated into other parts of the work plan.

3,980,000

4,000,000

560,000

560,000

94°00'

31°00'

31°00'

520,000

520,000

4,000,000

30°55'

30°55'

94°00'

3,980,000

LEGEND

- 96 U.S. Highway
- 63 State Highway
- 776 Farm to Market Road
- Paved Road
- Improved Road
- Town
- City Boundary
- Pipeline
- Powerline
- Railroad
- Drainage
- Watershed Boundary
- S1 Valley Section
- Outline of Floodwater Damage Area
- R-1 Reach

S32 S31 S30 S29 S28 S27 S26 S25 S23 S19 S22 S8 S18 S14 S12 S7 S6 S5 S4 S3 S2 S1

New Blox

JASPER

Fourmile Creek

Spring Branch

Blue

Trotti Br.

Brown Creek

SANTA FE

Creek

AND GULF COLORADO

Sandy

Little Sandy

PIPELINE

POWERLINE

Reach 1

Reach 2

Reach 3

Reach 4

2800 2799 776 63 96 190 252 1408

School Plant

SANDY CREEK WATERSHED
TEXAS

Figure 1

PROBLEM LOCATION MAP
SANDY CREEK WATERSHED
A portion of
JASPER COUNTY, TEXAS
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS

0 1 2

Approximate Scale - Miles
APPROX. SCALE 1:63,360

Base Map compiled from USGS quadrangles and General Highway Map. All planimetric features as well as Lat. & Long. and State Plane Coordinates taken from these sources.

11-71 4-R-31089

April 1970 Rev. 11-71 4-R-29170

USDA SCS-FORT WORTH TEX. 8078

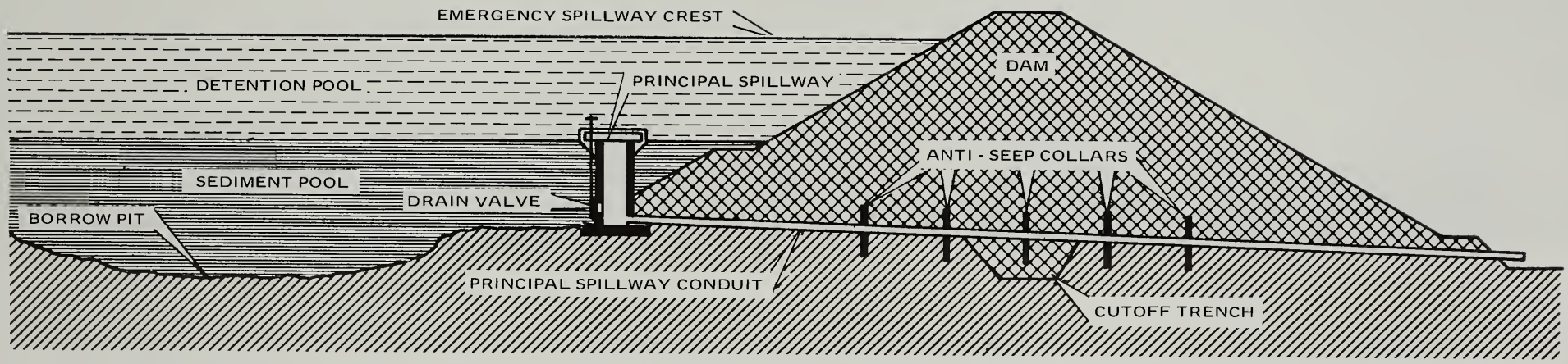


Figure 2

SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

U. S. D. A., SOIL CONSERVATION SERVICE

USDA-SCS-FORT WORTH, TEX. 1974

REV. 5-74 4-L-10071-C

Emergency Spillway Diversions shall have 13 ft minimum base width; 3:1 side slopes, and 18" effective height. Effective height may be secured by grading a channel across high points to reduce the height of fill required in low areas. Where a channel section is required, the minimum bottom width of channel shall be 12 ft

Stream Channel within embankment area shall be shaped and cleared of objectionable material. (See sheets 16 and 17 and Construction Spec. 21.)

A minimum of 6" topsoil shall be placed in the Emergency Spillway and on all Earth Fill Areas. (See Construction Specification 26A.)

Fence Legend

— C — C — Fence to be constructed under this contract

— R — R — Fence in construction area to be removed by the contractor.

——— Fence as constructed

Waste Area

19' Berm El 316.2, from Sta 13+75 to approx Sta 15+00.

Emergency Spillway Diversion

Waste Area

As Built

332

Building Do not disturb

16' Wire Gap

118°15'

Berm width transitions from 10' at Sta 14+80 to 15' at Sta 18+50 Sta 18+50 to approx. Sta 15+30 Berm shall be 15'.

Downstream Toe

10' Berm El 325.0

25:1

Permanent Reference Marker Sta 0+50 El 344.07

16' Wire Gap

El 323.0

El 319.5

35' Berm

Upstream Toe

Waste Area

PI Sta 18+46

Sta 10+00 on ℄ of Emergency Spillway = Sta 17+83 on ℄ of Dam

Permanent Reference Marker Sta 19+42 El. 334.94

Fill Area – Fill shall be placed and paid for as "Earth Fill Embankment

PI Sta 17+20

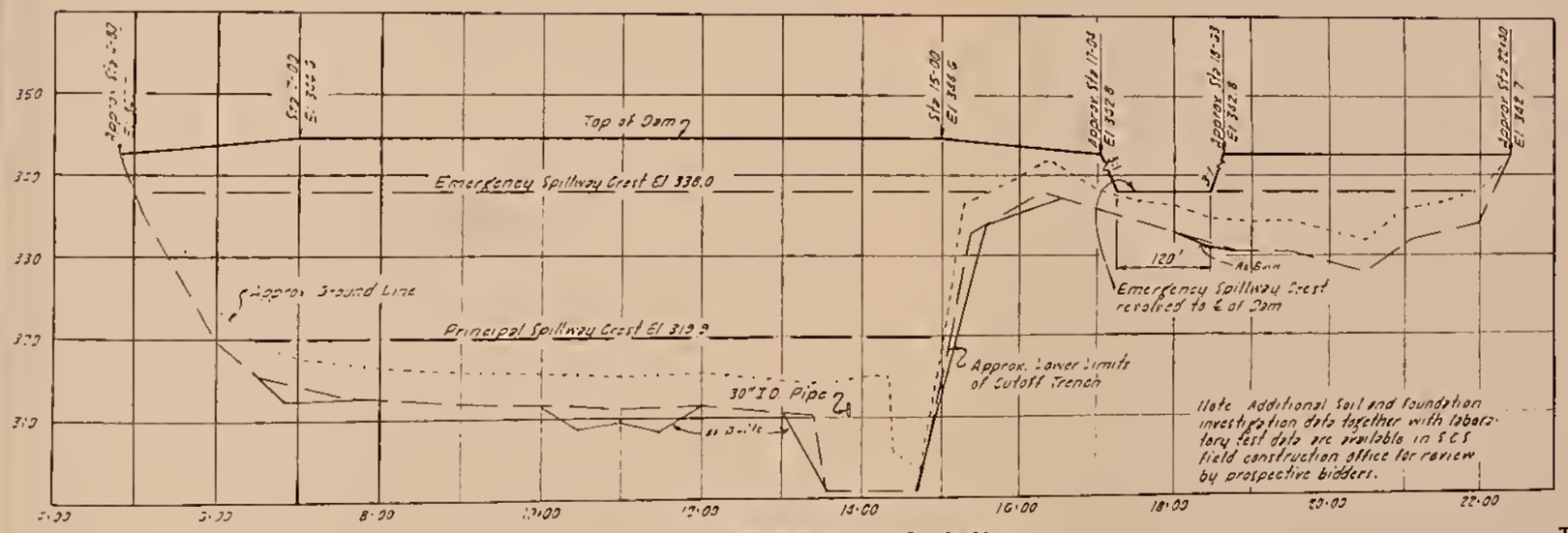
As Built

Sta 7+00 on ℄ of Principal Spillway = Sta 13+85 on ℄ of Dam

PLAN OF EMBANKMENT AND SPILLWAYS

0 100 200 300 400 500

SCALE IN FEET



PROFILE ON ℄ OF DAM

FIGURE 3

TYPICAL FLOODWATER RETARDING STRUCTURE EMBANKMENT PLAN AND PROFILE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

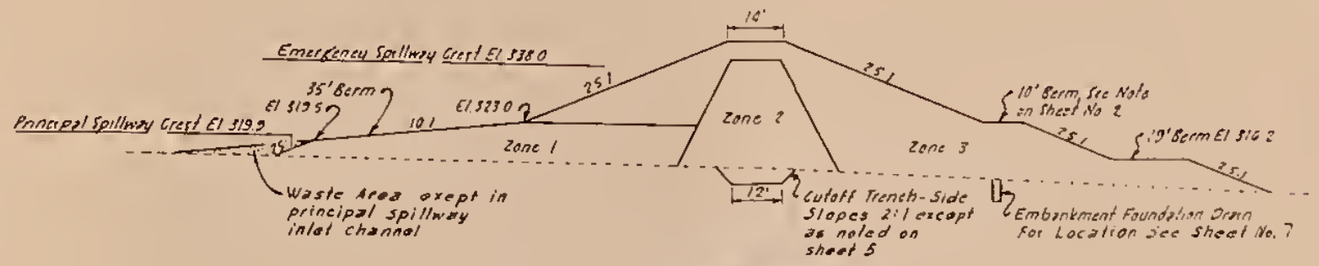
REV. 11-74 **4-E-28,734**

Elevation	Surface Ac.	Storage	
		Acre Feet	Inches
316.0	11.8	5.9	0.02
319.9	34.0	91.0	0.31
320.0	38.5	98.5	0.33
322.5	50.0	191.0	0.65
324.0	59.9	287.3	0.97
328.0	106.0	615.1	2.09
332.0	156.5	1132.1	3.86
336.0	209.4	1859.9	6.32
338.0	243.0	2311.0	7.85
340.0	276.1	2830.9	9.61
342.0	348.8	4070.7	13.83
Top of Dam (effective) El			342.7
Emergency Spillway Crest El			338.0
Principal Spillway Crest El			319.9
Sediment Pool El.			319.9
Drainage Area, Acres			3533
Sediment Storage, Acre Feet			227
Floodwater Storage, Acre Feet			2084
Max Emerg. Spillway Cap. c.f.s.			3217
Max Prin Spwy. Discharge @ El 3338 c.f.s.			115

GENERAL PLAN OF RESERVOIR

0 660 1320 1980 2640

SCALE IN FEET



TYPICAL SECTION

MATERIALS PLACEMENT DATA																			
Embankment Zone No. 1/	Source of Fill Materials			Type or Unified Classification	Field Control Test		Placement and Compaction Requirements						Laboratory Test Data						
	Material Location 2/	Average Depth, ft.			ASTM Test		Max. Allowable Particle Size	Max. Uncompacted Layer Thickness	Specified Compaction Class	Min. Dry Density, Percent of Field Test Max. Dry Density	Moisture Limits, Relative to Field Test Optimum		ASTM Test		Curve No.	Max. Dry Density, p. c. f.	Optimum Moisture %
		From	To		Number	Method					From	To	Number	Method			
1,2,3	Borrow	0	6	CL-Silty Clay	D-698	A or B	6"	9"	A	90	-2	Up	D-698	A	1	108.5	15.5
1,2,3	Borrow	0	7	CL-Silty Clay	D-698	A or B	6"	9"	A	90	-2	Up	D-698	A	2	111.5	15.5
1,2,3	Borrow	0	6	CL-Silty Clay	D-698	A or B	6"	9"	A	90	-2	Up	D-698	A	3	112.0	15.0
1,3	Borrow	6	11	CL-Silty, Sandy Clay	D-698	A or B	6"	9"	A	90	-2	Up	D-698	A	4	112.5	15.5
1	Em. Spwy.	4	14	SC-Clayey Sand	D-698	A or B	6"	9"	A	90	Opt.	Up	D-698	A	5	112.5	16.0
1	Em. Spwy.	6	11	SC-Clayey Sand	D-698	A or B	6"	9"	A	90	Opt.	Up	D-698	A	6	111.5	16.5
3	Em. Spwy.	8	14	SM-Silty Sand	D-698	A or B	6"	9"	A	90	Opt.	Up	D-698	A	7	110.0	15.5

1/ The zone boundaries shown in the typical section are approximate. They may be varied as permitted by the Engineer, to allow the use of all suitable and needed materials from the required excavations.

2/ Materials from the required excavations that are not tabulated in the table above and that are suitable and acceptable for earth fill shall have the same placement and control requirements as that specified for like materials covered under Materials Placement Data.

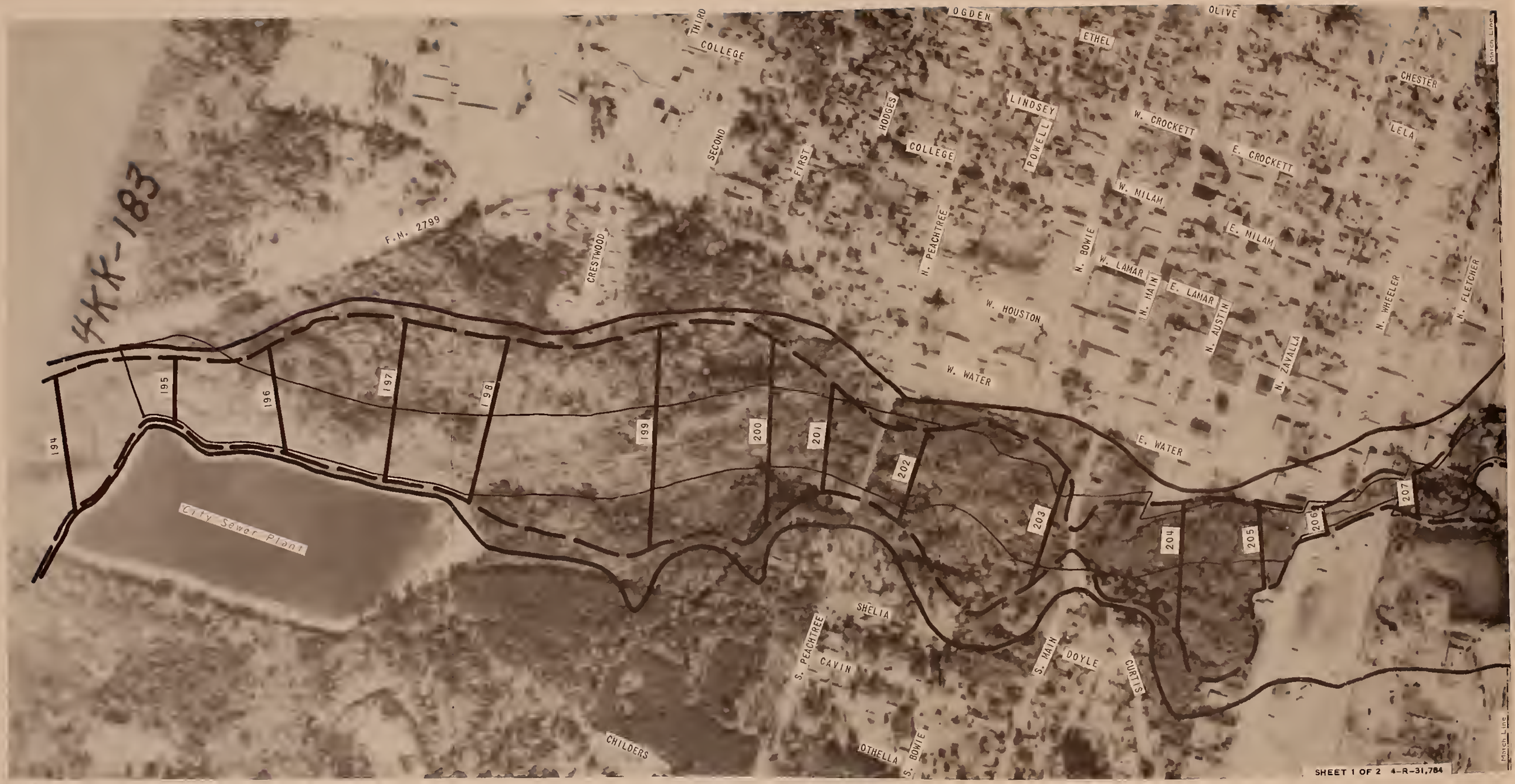
ZONED EMBANKMENT DATA

FIGURE 3A

TYPICAL FLOODWATER RETARDING STRUCTURE
GENERAL PLAN OF RESERVOIR

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

REV. 11-74 4-E-28,734



USDA-SCS-FORT WORTH, TEX., 1974

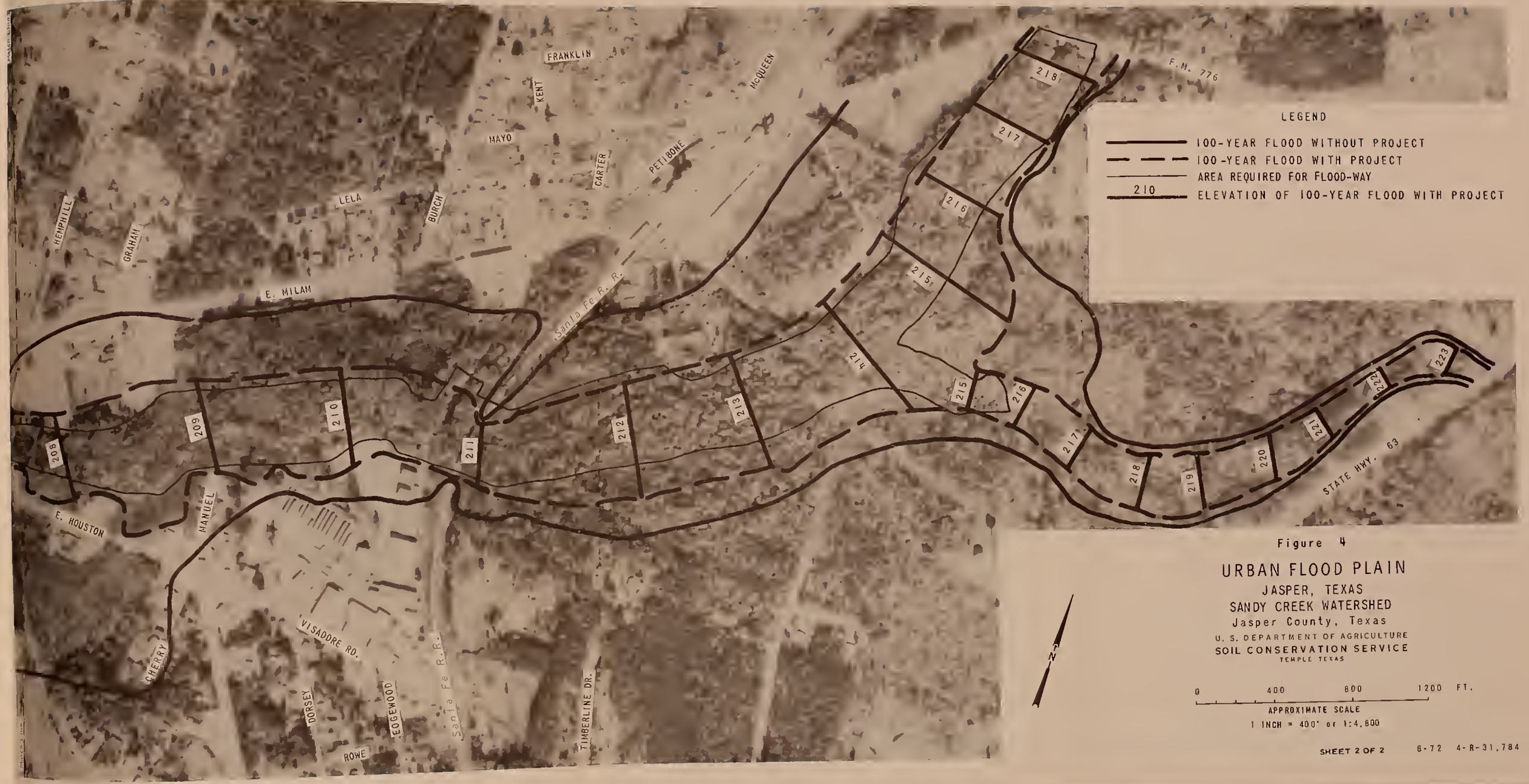


Figure 4

URBAN FLOOD PLAIN

JASPER, TEXAS
SANDY CREEK WATERSHED
Jasper County, Texas
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE TEXAS

SHEET 2 OF 2 6-72 4-R-31,784

U. S. DEPARTMENT OF AGRICULTURE — SOIL CONSERVATION SERVICE. TEMPLE. TEXAS

3,960,000 — 4,000,000

560,000 — 560,000

520,000 — 520,000

94°00'

31°00' — 31°00'

30°55' — 30°55'

SITE NUMBERS AND DRAINAGE AREA IN ACRES

Site No.	Acres
1	1203
2	1402
3	1203
4	1677
5	1069
6	1114

APPROXIMATE ORAINAGE AREA 24,960 ACRES

LEGEND

- 96 U.S. Highway
- 63 State Highway
- 776 Farm to Market Road
- Paved Road
- Improved Road
- Town
- City Boundary
- Pipeline
- Powerline
- Railroad
- Orainage
- Watershed Boundary
- Floodwater Retarding Structure
- Floodway
- Orainage Area Controlled by Structure
- Benefited Area
- (1) Site Number

PIPELINE

Fourmile Creek

Relocate County Road

SANTA FE

New Blox

Spring Branch

Blue

Brown Br.

Trail

Creek

POWERLINE

GULF COLORADO AND SANTA FE

Sandy Creek

Sandy

Little Sandy Creek

Sta. 285+00

Sta. 12+00

Sta. 0+00

Sta. 144+00

JASPER

Sewage Plant

2800 — 2799 — 1408 — 776 — 777 — 252 — 190 — 63 — 96

SANDY CREEK WATERSHED
TEXAS

Figure 5

PROJECT MAP
SANDY CREEK WATERSHED
A portion of
JASPER COUNTY, TEXAS

0 — 1 — 2

Approximate Scale - Miles

Projection Unknown compiled at 1 inch = 11,880 (2 inches equal 1 mile) and reproduced at 1 inch = 21,120 (3 inches equal 1 mile) and 1 inch = 63,360 (1 inch equals 1 mile).

Base map compiled from USGS 7½ minute quadrangles and General Highway Maps.

Revised May 1974 — 4-R-31088

April 1970 Rev. 11-71 — 4-R-29170